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# USER'S GUIDE FOR COMBIMAN PROGRAMS (COMputerized BIomechanical MAN-Model)

## VERSION 7

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**FOR THE COMMANDER**

CHARLES BATES, JR.
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The guide to operate the four main programs includes descriptions of the processing capabilities for each program, definitions and examples of all input and output data formats, procedures to execute the programs, and explanations of all diagnostic messages generated by the programs.

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The guide to operate the four main programs includes descriptions of the processing capabilities for each program, definitions and examples of all input and output data formats, procedures to execute the programs, and explanations of all diagnostic messages generated by the programs.

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## SUMMARY

This User's Guide describes the procedures to operate the Air Force Aerospace Medical Research Laboratory's (AFAMRL) COMputerized BIomechanical MAN-model (COMBIMAN) programs. The Guide is based on the COMBIMAN system of programs as of 1 May 1983. An introduction to the man-model and the conventions used to develop and analyze crew station configurations are included in the guide. It also contains the operations of the programs included in the COMBIMAN system. These programs include the interactive graphics programs CBM07 to generate COMBIMAN, and the three key data base creation/modification programs CBMAM, CBMCM, and CBMVM, which create and maintain the Data Bases of anthropometric surveys, crew station configurations, and visibility contour definitions respectively. The guide also contains a complete description of the use of the off-line plot program, CBMOFF. The first four programs are designed to run on an IBM 370 OS/VS computer and CBMOFF is designed to run on a CDC Computer.

The guide to operate the four main programs includes descriptions of the processing capabilities for each program, definitions and examples of all input and output data formats, procedures to execute the programs, and explanations of all diagnostic messages generated by the programs. The requirements to run CBM07 and the available functions on the COMBIMAN are also described in the guide.

## PREFACE

This work was performed under USAF Contract F33615-81-C-0505 entitled Biomechanics of Cockpit Evaluation. The government work unit number for this contract is 71840838. The contract monitor and technical advisor is Dr. Joe W. McDaniel of the Workload Ergonomics Branch of the Air Force Aerospace Medical Research Laboratory. The development of the programs referred to in this User's Guide was performed by the University of Dayton Research Institute (UDRI). The UDRI Technical Report number for this Guide is UDR-TR-85-04.

The purpose of this report is to provide a detailed guide to use the key computer programs of the AFAMRL COMBIMAN system. It does not document the theoretical approach taken in developing any of the computer programs. The manipulation of the model and crew station is straightforward and the information in Section 2 will enable a noncomputer person to run the interactive graphics program CBM07. Because of the technical nature of the plot program described in Sections 4, 5, and 6, the person assigned to interpret and use these programs should possess some experience in computer programming. Since all the programs are considered relevant to the COMBIMAN system, they are all included in this guide for sake of completeness. The description of the man-model and crew station in the introduction are presented as general background material needed to use the programs efficiently.

The authors would like to acknowledge the assistance and the technical support provided by Mr. Charles Clauser of the Workload and Ergonomics Branch of the AFAMRL, Mr. Leroy Gibbons, Mr. Phil Krauskopf, Mr. John Quinn, and Mr. Thomas Held of UDRI. The authors would like to thank Mrs. Charlene Dunson of UDRI for her patience while typing this User's Guide.

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# SECTION 1
# INTRODUCTION

During the design and analysis phases of crew station development, it is essential to assess the capabilities, inadequacies, and dangers of the crew station environment with respect to the human operator. The conventional method for accomplishing this has been to build mock-ups and to use an undetermined number of "representative" test pilots to evaluate the work environment and control placement. The mock-ups tend to be costly and time consuming to build, as well as somewhat inflexible during testing. The sample size of the "representative" pilots depends on the availability of pilots and the whims of the designers.

The COMputerized BIomechanical MAN-model (COMBIMAN) system of programs has been developed to assist in the design and analysis phases of crew station development. It has been designed to serve as an interactive-computer-graphics-assisted engineering tool to represent geometric and physical properties of an operator in a crew station. It has applications in evaluating conceptual or existing crew stations. The COMBIMAN is a three-dimensional man-model and can be viewed from any plane or angle. Since the man-model and crew station exist only on the Cathode Ray Tube (CRT) and in computer memory, no significant amount of time or materials is invested in making modifications. Alternative designs may be thoroughly evaluated and permanently recorded by a hard copy plot or a listing of the crew station data and man-model (McDaniel, 1976). Because of these capabilities, the COMBIMAN should reduce the need for building mock-ups, as the designer can construct a crew station in three dimensions on a CRT and can assess interactions using man-models of various body sizes and proportions.

## 1.1 HARDWARE REQUIREMENT

The COMBIMAN system of programs consists of the interactive computer graphics COMBIMAN program CBM07; as well as data base creation/maintenance programs CBMAM, CBMCM, and CBMVM; and an off-line plot program CBMOFF. The programs CBM07, CBMAM, CBMCM and CBMVM are coded in FORTRAN IV and are compiled using IBM FORTRAN G compiler. There are a few subroutines in CBM07 which are coded in IBM assembly language. IBM System/370 Operating System Graphics Subroutine Package (GSP) for FORTRAN IV is used to create displays on the CRT. Versatec VERSAPLOT-07 software plot package is used for the on-line plotting. The program CBMOFF is written in FORTRAN IV to run on a CDC computer.

The program CBM07 is intended to run on an IBM 370 OS/VS compatible environment using an IBM 2250-3 compatible display tube such as IBM 3250, IBM 5080, ADAGE 4250 etc. and an on-line Versatec 22 inch electrostatic plotter. In the absence of an on-line plotter, the ON-LINE PLOT Function (see Section 2 for details) will not be available to the user. All subroutines which call Versatec VERSAPLOT-07 software are listed in the appendix and the source codes are provided with the COMBIMAN distribution tape.

The program CBM07 requires about 650K bytes of computer memory and a minimum of 20K bytes of graphics buffer control area. Six data sets residing on direct access device (disk) are used for I/O operations.

## 1.2 MAN-MODEL GENERATION

The man-model used in COMBIMAN is based on a 35 link-skeletal system. These links connect major points of rotation of the body segments as shown in Figure 1. The lengths of the links as well as their orientations with respect to their adjacent

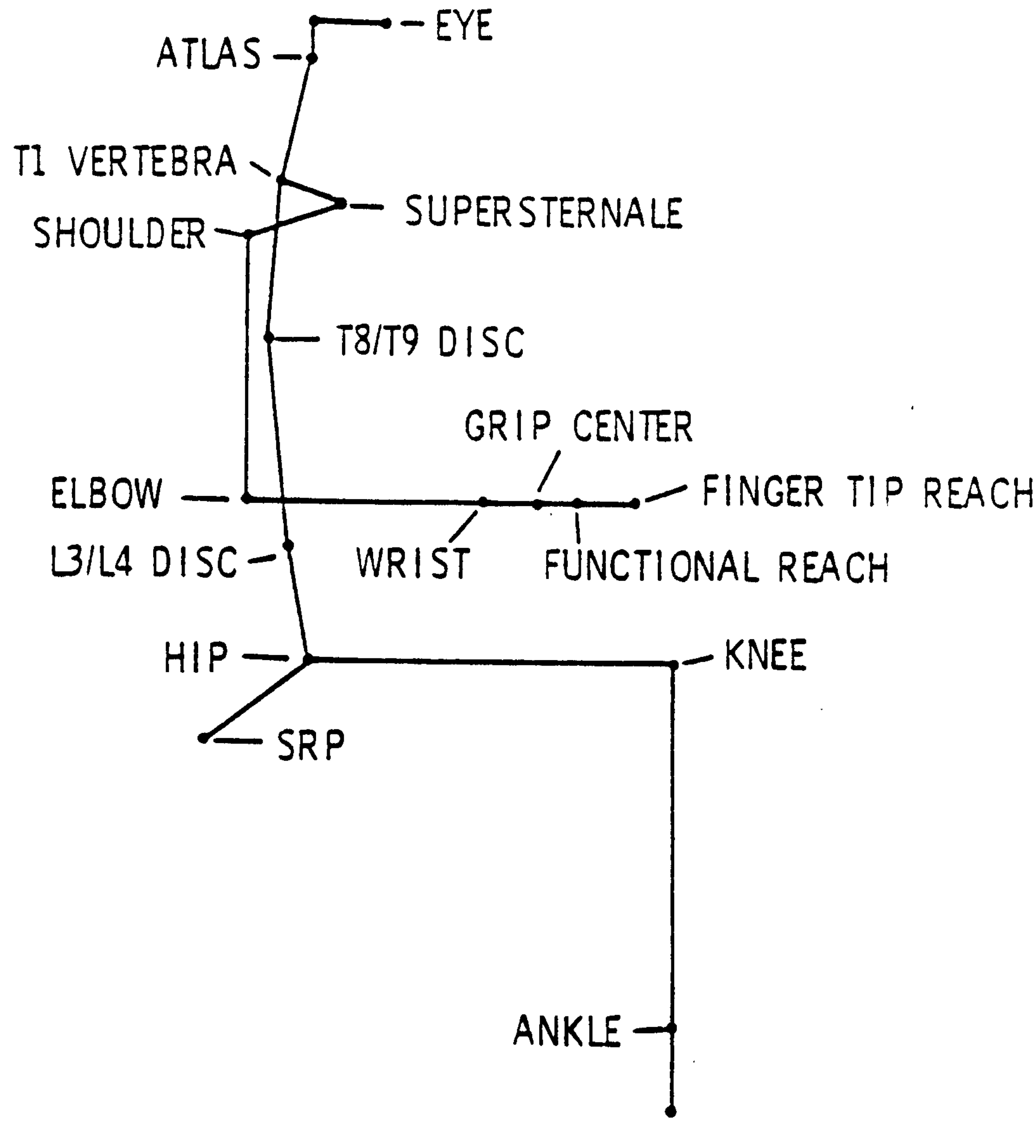



Figure 1. COMBIMAN Link System - Side View.

links in the skeletal system can be modified by the user. Since the segment lengths of link-lengths are generally internal dimensions and are difficult to measure on a live subject, the link-lengths are derived from 12 readily measurable anthropometric surface dimensions. The sets of anthropometric variables available to users are highly correlated to mass or length of body segments. A more detailed description of these variables is given in Section 3. Section 2 describes the ways the user can change the proportions of the man-model by specifying new values for the surface dimensions.

The link system is defined and generated as shown in Figure 1 using data available from the Anthropometric Data Base or from data supplied by the user. As the generation of the man-model continues the link data, and other data in external files, are used to develop the final presentation of the man-model. These stages of model development are transparent to the user; only the completed man-model is displayed on the CRT (Figure 2).

The primary viewing planes for COMBIMAN are the X-Z plane (side view), the X-Y plane (top view) and the Y-Z plane (front view). The man-model need not be parallel to any one of these three orthogonal planes; it can be rotated by an angle with respect to these planes. Figures 1 and 2 show COMBIMAN in the X-Z plane (side view).

## 1.3 CREW STATION DESIGN

The COMBIMAN system assumes that crew stations consist of panels and controls. There are two options available for setting up the crew station data base: one with 3 to 6 vertices using the program CBMCM, which was the only method through Version 5, and a new one using CBMCM2 which allows 1 to 25 vertices per

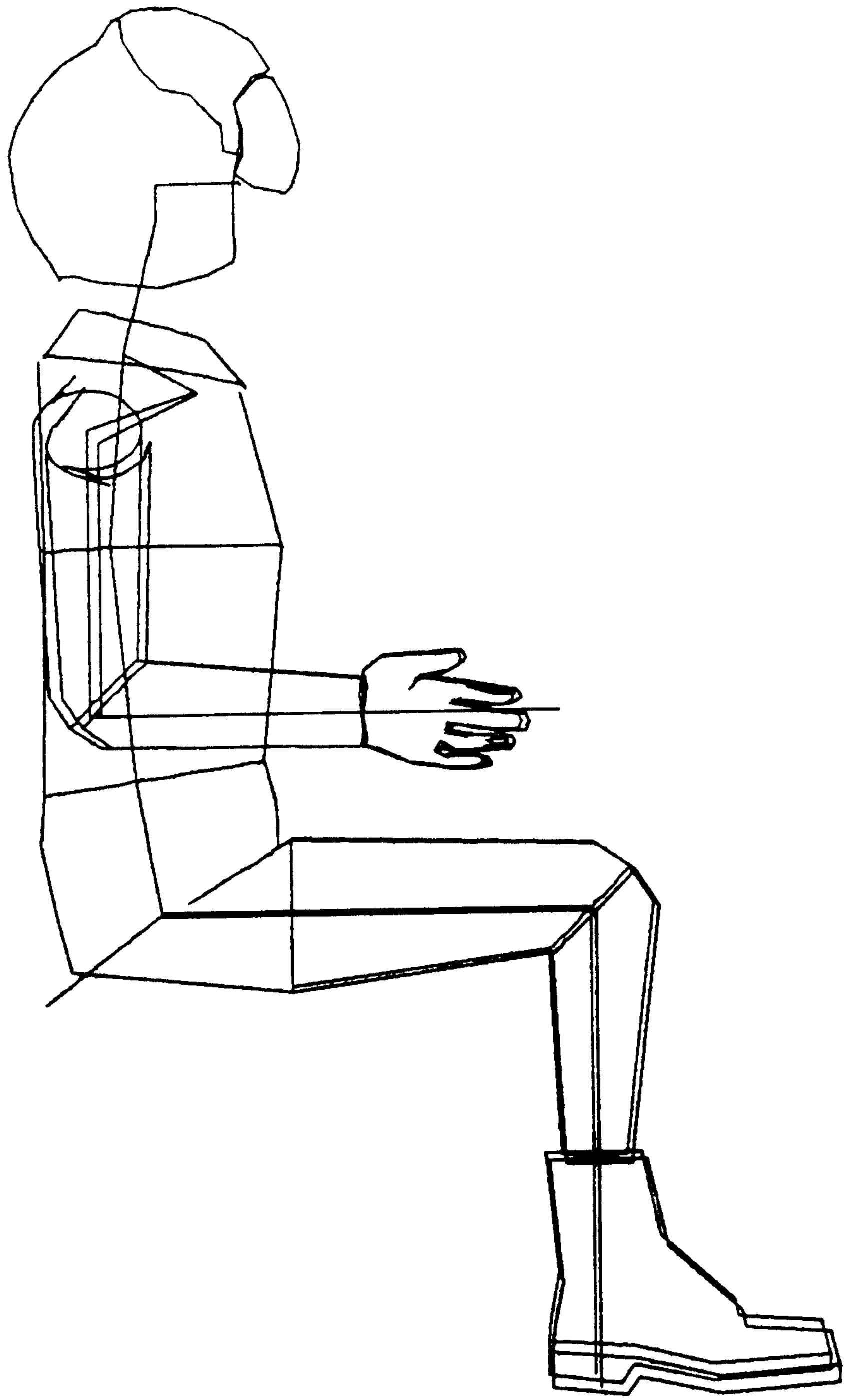


Figure 2. Enfleshed COMBIMAN as it Appears on the CRT.

panel. Thus, old data bases will continue to be supported, but a conversion program is also included to convert old CBMCM input data to the new CBMCM2 format. A crew station may have up to 250 panels with 3 to 6 vertices and 150 controls which may or may not be located on defined panels. Alternately, using the program CBMCM2 the user may create a new crew station data base where each member crew station may have up to 250 panels with 1 to 25 vertices each. In order to fetch this new data base, the user has to set the state switch 23 "ON" (see Section 2 for details). Although the crew stations used in COMBIMAN are usually aircraft crew stations, it is possible to construct and display any work space requiring interaction by a seated operator. This would include automobile instrument panels, industrial configurations, and control panels for other types of vehicles.

Two methods are used to generate and display crew stations. The designer can either use an existing or conceptual configuration, or can construct a new one on the Cathode Ray Tube using the available interactive graphic options. In the first method, panels and controls for existing or conceptual configurations are coded onto computer cards, or magnetic tape, or direct access disk, and are entered into the Crew Station Data Base. These data are accessed by the user through the interactive graphics program. In the second method, the user can design crew stations on the CRT, using an alphanumeric keyboard and the program function keys, following the basic series of steps similar to those used on a drawing board.

A crew station entered into the program exists in three dimensions and the man-model can interact with it. Since the CRT has only two dimensions, the 3-D man-model and crew station are projected on the screen in the orientation selected by the user. The display can then be rotated within the Display Area to suit the designer's needs. An example of the display with a man-model and crew station rotated -15 degrees in pitch and 15 degrees in

yaw is shown in Figure 3. Note that the Roll, Pitch, and Yaw angles are displayed at the upper right hand corner of the display area.

## 1.4 EVALUATION TECHNIQUES

A number of evaluation techniques have been implemented into the COMBIMAN system. They are designed to allow the user to vary the proportions of the man-model to suit a particular situation or problem, and to position the man-model within the crew station to assess human performance and to aid in placement of controls and panels.

In order to display the man-model on the CRT, the COMBIMAN system uses anthropometric surface dimensions data either from the on-line anthropometric data base or from data supplied by the user in card image format. The user can add descriptions of other anthropometric data so that other populations may be represented by the COMBIMAN. To define the man-model, the program CBM07 (COMBIMAN program Version 7) requires values for the 12 anthropometric variables which generate the 35 internal link lengths. In one option the user must supply values for all 12 variables. The second option however, requires the user to supply values for one mass related variable and one length related variable and let the program compute the other ten variables using multiple regression equations. The user supplied data may be (a) direct measures obtained from specific subjects; or (b) percentile values chosen from COMBIMAN Anthropometric Data Base. The latter option is generally the most useful, as it limits the range of values for user supplied dimensions and eliminates unrealistic combinations of dimensions. The program CBM07 may terminate abnormally when unrealistic combinations of anthropometric dimensions are supplied.

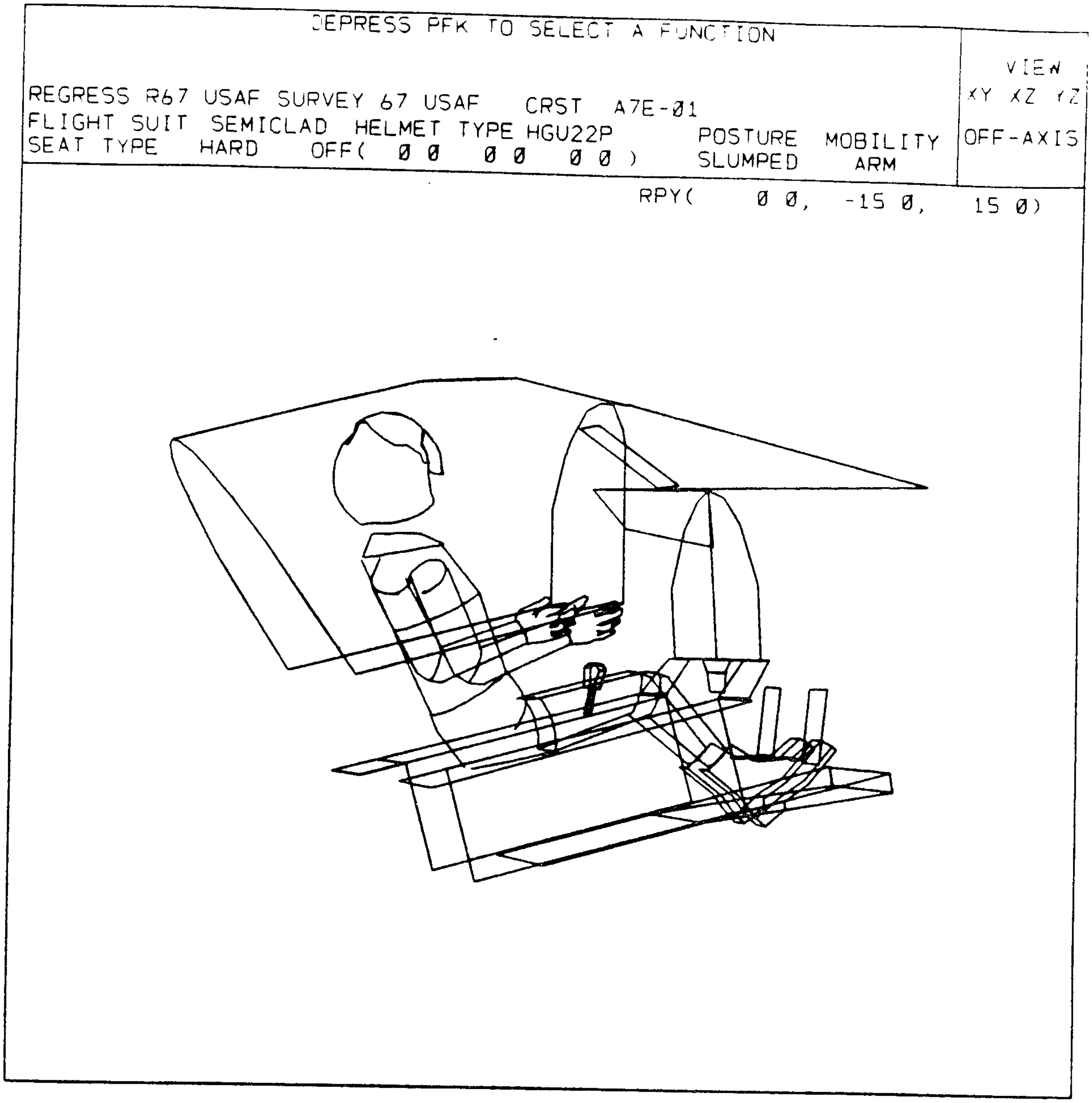



Figure 3. COMBIMAN CRT Display with Man-Model and A7E-01 Crew Station Rotated -15 Degrees in Pitch and 15 Degrees in Yaw.

The man-model can be positioned in a crew station by directly entering sets of rotational angles used to position the links of the model, or with the PERFORM REACH ANALYSIS function (see Paragraph 2.2.11) by specifying a point on the display. The latter method applies to reach involving the arms and incorporates automatic restrictions to mobility. The user may also initialize the man-model in the standard anthropometric seated measuring posture (ERECT POSTURE), the SLUMPED POSTURE, which is an erect posture positioned in a 13 degree seat back angle and six degree seat pan angle, or a third posture (PRGM'D POSTURE) interactively designed by the user.

Other information available to the user includes hard copy plots of the display, printed output showing the three-dimensional real world coordinates of the man-model and of the panels of the crew station, and visibility plots, which give the user information on the visual field of the crew station based on the eye position of the man-model.

## 1.5 THE COMBIMAN PROGRAMS

The main program in COMBIMAN system is the interactive graphics program CBM07 which allows the user to generate a variable size man-model and to assess its interaction with new or existing crew stations. Before the user can define the proportions of the man-model or call up crew stations and visibility contours for evaluation, the files which store the anthropometric, crew station, and visibility member data must be created. This is accomplished by using three specialized file creation/modification programs, each dealing with a particular type of data set containing the anthropometric, crew station, or visibility members. Similar sets of commands are used by each program to initialize the file, to add or delete data, to write existing data to the printer, or to punch data to cards. The data flow of the COMBIMAN program is shown in Figure 4. Figure 4 also shows a fourth file, the initialization data set, which

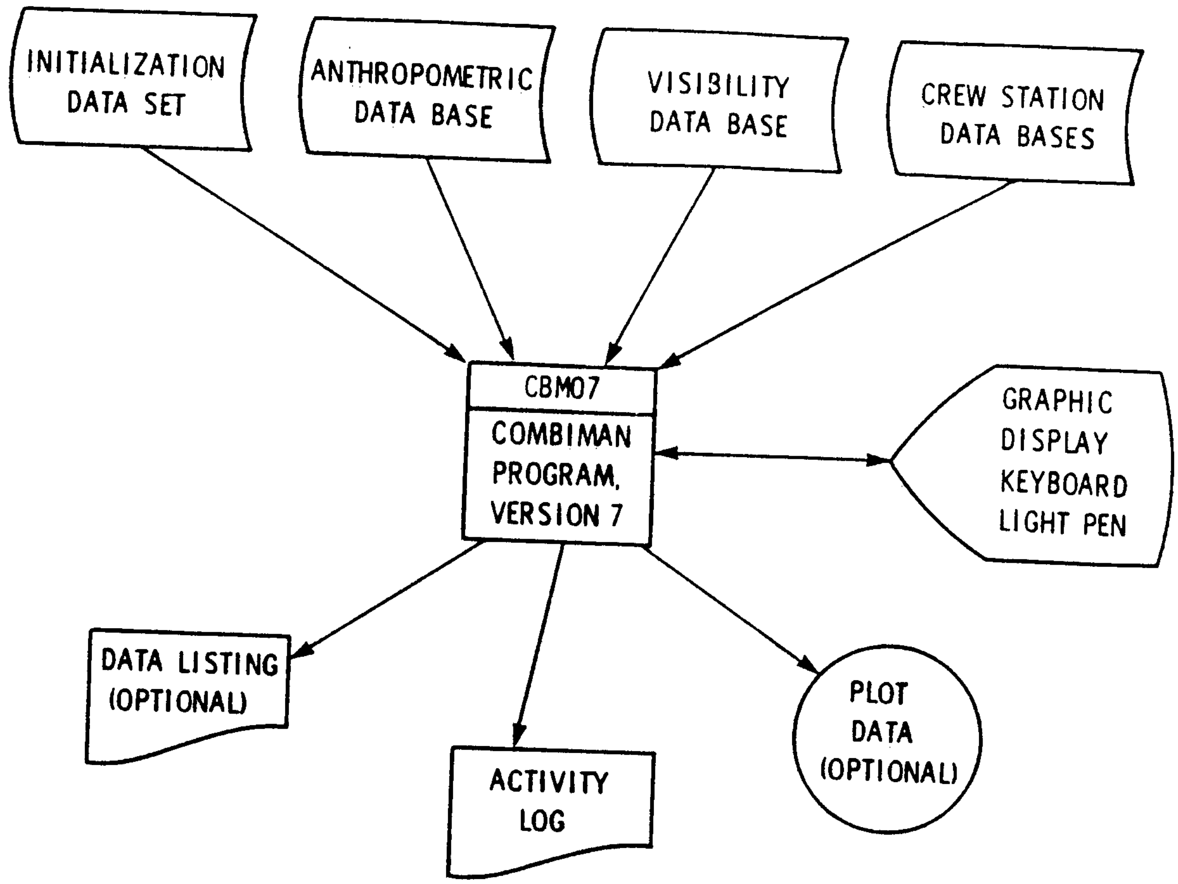



Figure 4. Data Flow in the COMBIMAN Program CBM07.

contains data used to construct the man-model and cannot be modified by the user.

The following sections explain the operation of five key programs of the COMBIMAN system, including the interactive graphics program CBM07, the off-line plot program CBMOFF, and three of the file manipulation programs which maintain the data files used as input to CBM07. The manipulation of the man-model and crew station using CBM07 is straightforward. Sections 1 and 2 of this guide provide a designer not skilled in computer programming with sufficient information to use CBM07 interactively. Due to the technical nature of the data and operations described in Sections 3, 4, 5, and 6 some computer skill is required to interpret and use these programs.

Section 2 describes the use of the program function keys which may be activated by the user in program CBM07 to manipulate the man-model and to design and evaluate crew stations. This section includes examples of optional as well as standard output generated by the program, and lists of possible error or information messages generated by the program.

Section 3 describes the COMBIMAN off-line plotting program CBMOFF. This program uses data generated by CBM07 to produce plots of variable size, color, and content from the three-dimensional coordinate data. Input formats, plotting options, and program output are explained in this section.

The program which creates and maintains the Data Base containing the Anthropometric surveys, CBMAM, is documented in Section 4. The types of stored data, the sources for such data, and the formats for data input, sample output, and action and error messages are discussed. The uses of, and formats for, the commands or functions which manipulate the file as well as the data are also described.

The program which creates and maintains the Data Base containing the geometric descriptions of crew station configurations, CBMCM, is documented in Section 5. An alternate program CBMCM2 which creates or maintains crew station members consisting of panels with 1 to 25 vertices including open panels and a program which converts panel data from CBMCM (Version 5) input format to CBMCM2 (Version 6) input format are also described in Section 5. The program which creates and maintains the Data Base of geometric descriptions of crew stations for visibility plots, CBMVM, is documented in Section 6. Data sources and formats for input, output, and messages are also described for these programs. In addition, these sections contain examples of Job Control cards to run these programs.

## 1.6 NEW CAPABILITIES IN COMBIMAN VERSION 7

The COMBIMAN system of programs Version 7 is upward compatible with the previous version. Version 7 has the following new features.

- Display Visibility Plot on CRT SCREEN

An option has been added to allow the user to display the visibility plot on the CRT screen (See Paragraph 2.2.7.1 for details).

- Leg Reach

The PERFORM REACH function (PFK11) has been modified to include reach analysis for the left and right legs (See Paragraph 2.2.11 for details).

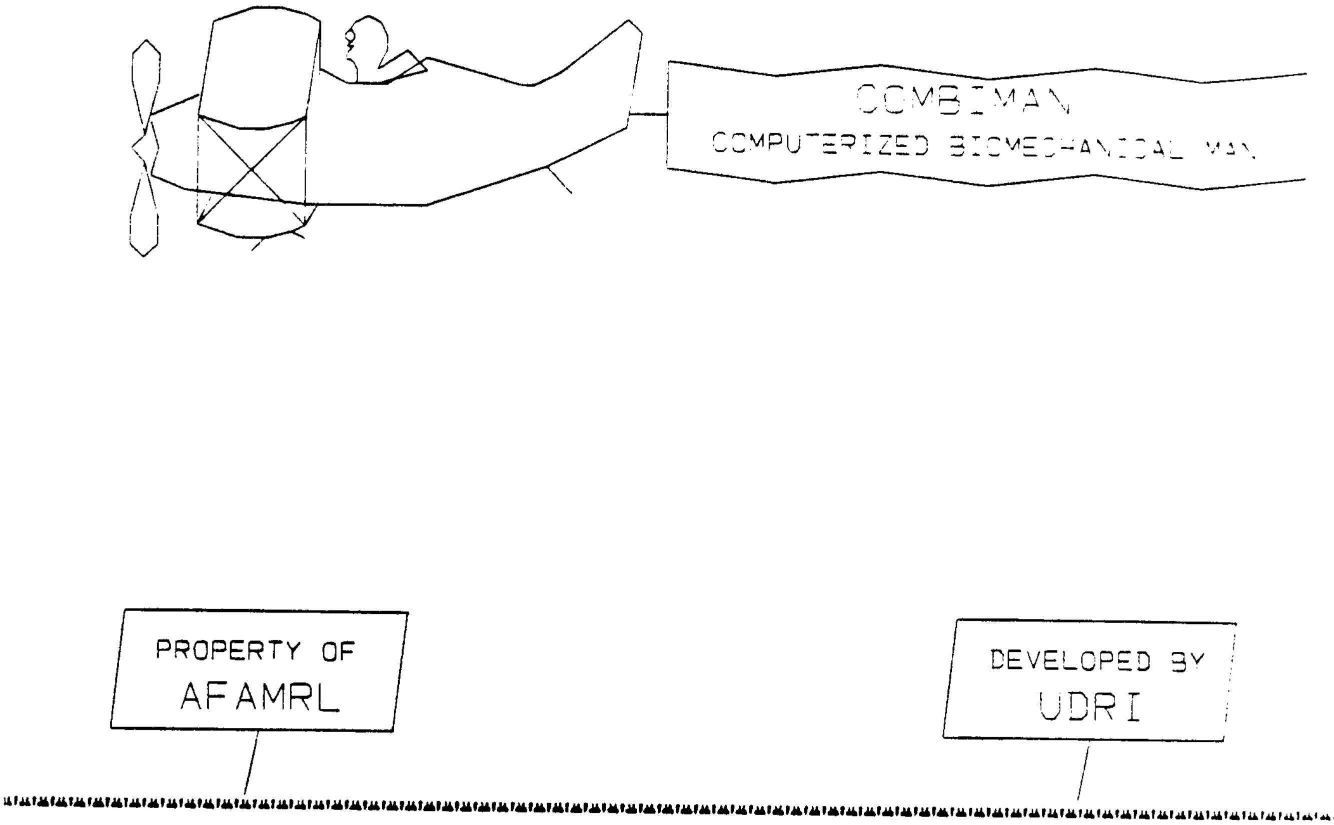
- STRENGTH ANALYSIS Function (PFK19)

The STRENGTH ANALYSIS function predicts the amount of force available for application from a seated position, on a lever, wheel or pedal control. When the STRENGTH ANALYSIS function is selected the 1st, 5th, 50th, 95th and 99th percentile of

force magnitude are displayed on the screen for the wheel or the pedal (Figure 57). The total force vectors, via x, y, and z components, and the force magnitudes, for the same percentiles are displayed for a lever control (Figure 58).

- REACH CURVE ANALYSIS Function (PFK20)

The REACH CURVE ANALYSIS function computes and displays the interaction between the maximum reach envelope and a specified crew station panel. Reach envelopes for combinations of clothing type, grip type and mobility restraints are available. Additionally, the user has the option of seeing the intersection on CRT screen or receiving a hard-copy plot of the panel and intersection (see Paragraph 2.2.19 for details).




BEGINNING OF COMBIMAN PROGRAM

# SECTION 2

# THE COMBIMAN INTERACTIVE GRAPHICS PROGRAM VERSION 7 - CBM07

Your tape actually has two different COMBIMAN programs: CBM07 and CBM7NOPL. The CBM07 program is for those users who have an on-line plotting capability, and the CBM7NOPL is for those users who do not have an on-line plot capability. The term CBM07 will be used in subsequent text. Remember, if you do not have an on-line plot capability CBM7NOPL is synonymous with CBM07 for your use.

This program uses an IBM 2250-3, IBM 3250, IBM 5080, ADAGE 4250 or equivalent Display Unit for designing and analyzing crew station configurations. The user at the display device controls the course of execution of program CBM07 using a Program Function Keyboard, a light pen, and an alphanumeric keyboard. Functions of the program are executed by depressing lighted Program Function Keys. This section describes the functions available to the COMBIMAN user, shows the output these functions generate, and traces through suggested execution sequences to generate the man-model, and to retrieve a crew station.

## 2.1 INTRODUCTION

The COMBIMAN program CBM07 enables the designer to bring together the information on anthropometry and crew stations stored on disk (see Sections 4 and 5) and to combine them with the interactive qualities of the Cathode Ray Tube. This enables one to evaluate real-life conditions, or to establish design criteria for new situations in a fraction of the time it would take using conventional methods.

For design and evaluation sequences, the 12-inch square CRT screen is partitioned into Prompting, Information, and Display areas (see Figure 5). The Prompting Area displays messages indicating what the user should do next. This area is also used to accept replies through the alphanumeric keyboard when requested. The Information Area displays the anthropometric survey name, the crew station name, flight suit and helmet types, seat type and offset, mobility, and posture information. The 10-inch square Display Area is used to display the man-model, crew station and roll, pitch and yaw angles, if different from zero. The three-dimensional coordinates of the reach point during Reach Analysis, the coordinates of the current vertex during a panel design, the coordinates of the vertices of identified panels, and the visibility member names during Visibility Plot Functions are also displayed in the Display Area.

Replies to prompting messages are given through the Alphanumeric Keyboard (ANKB), the Light Pen, or the Programmable Function Keys (PFK). Replies given through ANKB are displayed in the Prompting Area below prompting message and are processed by the program after simultaneously depressing the ALT CODING key and the "5" key on the IBM 2250-3, the "RETURN" key on the IBM 3250, the "RETURN" key on the IBM 5080 or depressing "CR" key on the ADAGE 4370. A light pen reply is given by aiming the light-pen (beam) at the desired response displayed on the CRT, and depressing the light pen barrel against the screen.

Figure 6 shows the COMBIMAN display on an ADAGE 4370 CRT. The user's left hand is on the Program Function Keyboard, and his right hand is using the Light Pen to identify a point on the screen. The Alphanumeric Keyboard is shown below the CRT.

### 2.1.1 Available Functions

The functions which are available to users fall into six basic categories, as shown in Figure 7. The first category, the Anthropometry Related functions, enables the user to retrieve data for a particular anthropometric survey from the

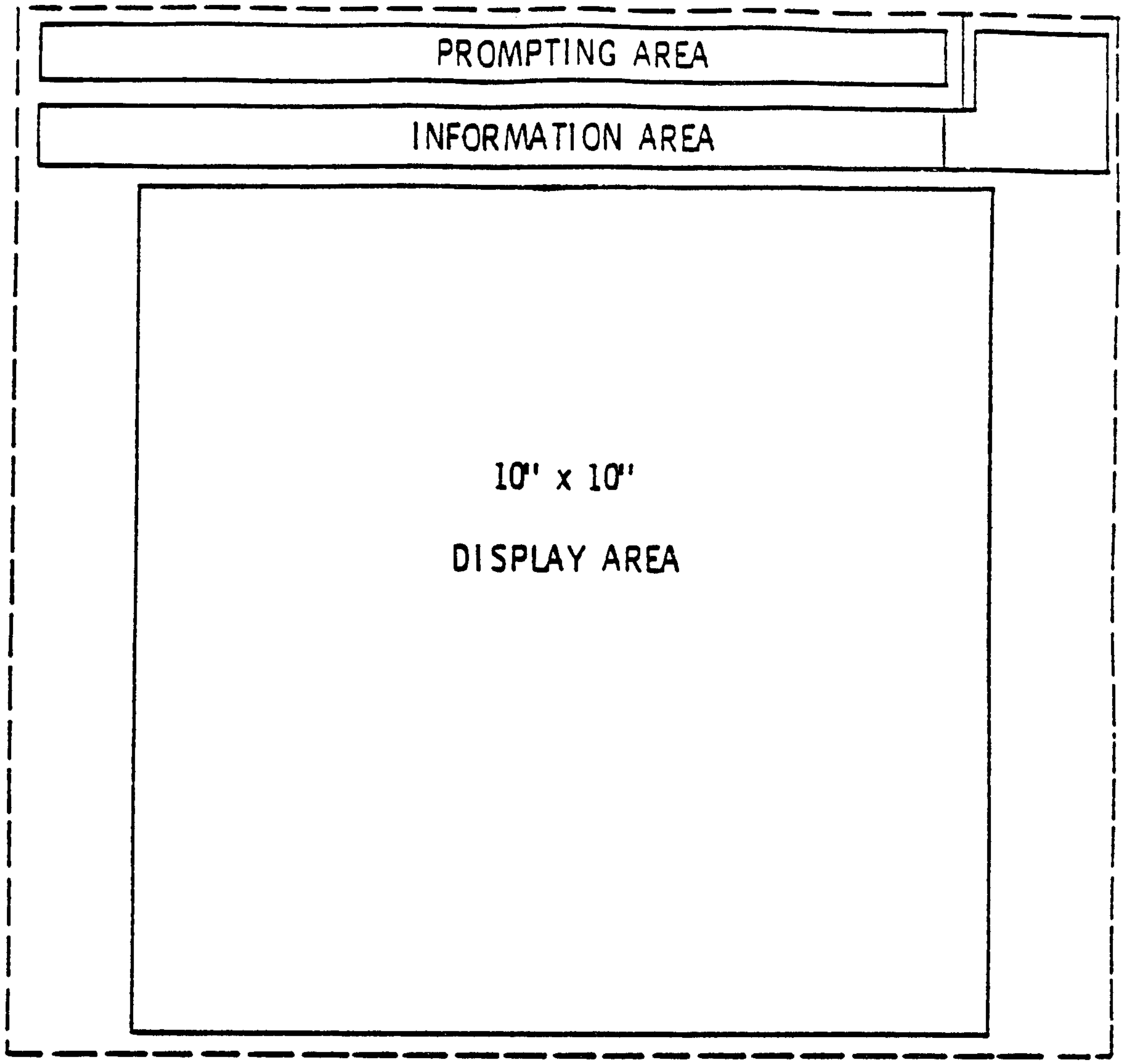



Figure 5. Format of ADAGE 4370 or IBM 2250-3 Display Unit. The program adjusts the size of the displayed image to fill the 10" x 10" display area. Selecting a front view may cause the man-model and crew station to appear larger, but the coordinate information remains unchanged.

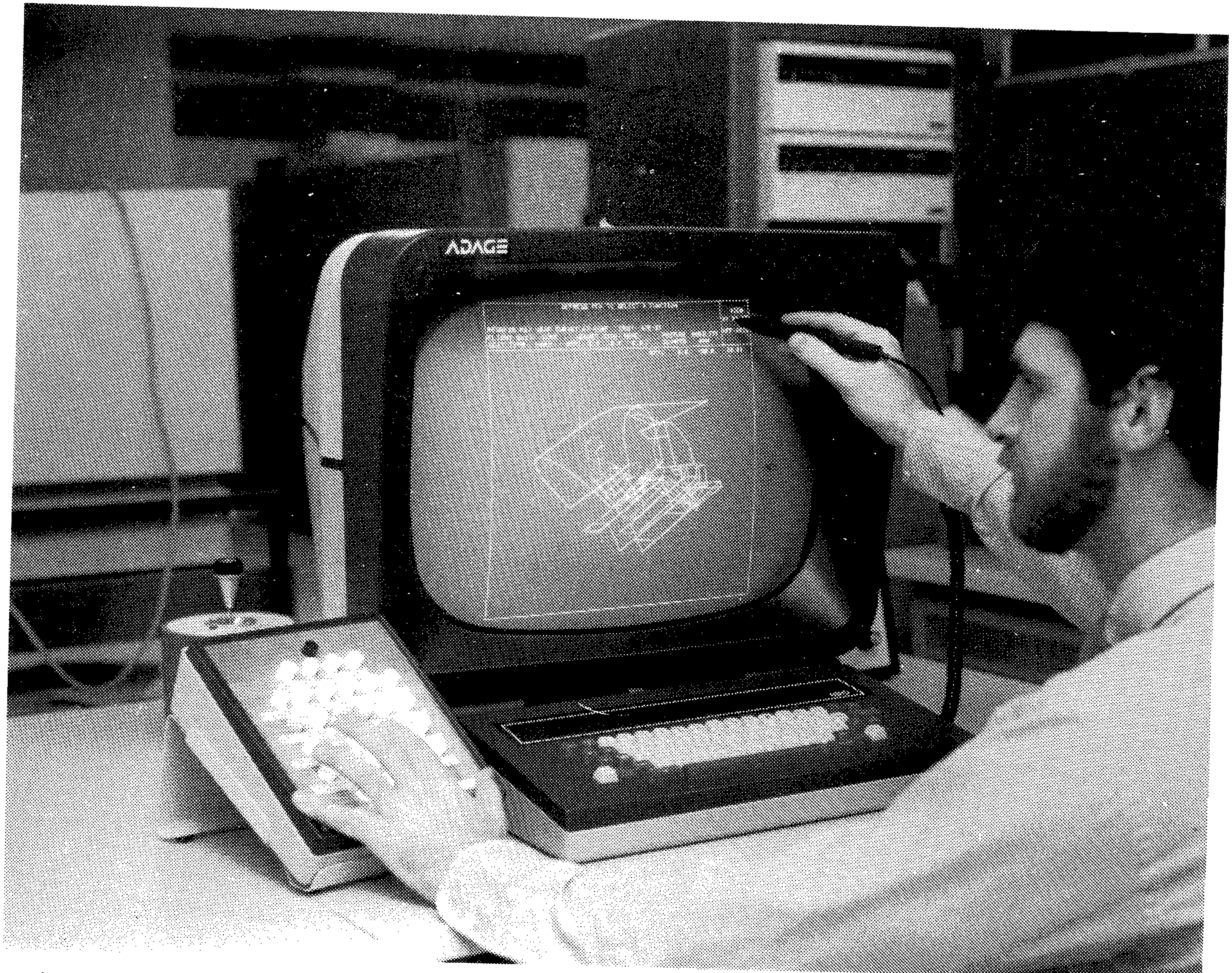



Figure 6. CRT Unit with Function Keys, Alphanumeric Keyboard and Light Pen.

| ANTHROPOMETRY-RELATED | CREW STATION-RELATED | DISPLAY-RELATED |
|---|---|---|
| Retrieve Anthropometry<br>Enter Twelve Dimensions<br>Enter Two Key Dimensions<br>Display Link Table<br>Display Anthropometric Table | Retrieve Crew Station<br>Design Panel<br>Delete Panel<br>Adjust Seat | Change View<br>Identify Object<br>Omit Object<br>Include Object<br>Change Perspective<br>Zoom |
| **MAN-MACHINE-INTERACTION RELATED** | **PRINTER/PLOTTER-RELATED** | **PROGRAM-EXECUTION RELATED** |
| Perform Reach<br>Change Posture<br>Reset Roll, Pitch, Yaw | Print Data<br>Plot COMBIMAN<br>Generate Visibility Plot<br>Dump CRT on Plotter | Set State Switch<br>Restart CBM07<br>End CBM07 |

Figure 7. Functions Available to COMBIMAN User.

Anthropometric Data Base, specify values for the surface dimensions of the man-model, and manipulate the geometry of the model to achieve the desired man-model configuration. The Crew Station-Related functions allow the user to retrieve existing three-dimensional crew station configurations from the Crew Station Data Base and then add to and modify the retrieved configuration. These functions allow users to start from the beginning of a design sequence and create a new crew station configuration. The Display-Related functions allow users to rotate and to magnify the contents of the display area. They also enable users to identify objects within the Display Area, or modify the contents by omitting or by including objects. The user can evaluate the interaction of man-model with crew station through the Man-Machine Interaction Related functions. These functions provide users with a reach analysis routine and change posture functions. The Printer/Plotter Related functions supply users with hardcopy output of the configuration of either the man-model or the crew station. The program generates plot output as soon as a plot function is activated, but the printed output occurs only at the end of the run. The final category, the Program Execution Related functions, permits the user to restart the program, or to end it. It also enables the user to set State Switches which either suppress or activate additional processing or printing.

A standard feature of the program is a listing of all actions taken by the user. This listing is a sequence of messages printed at the termination of the program CBM07.

### 2.1.2 Requirements

At the Wright-Patterson Air Force Base, AFAMRL/HESS facility, the program CBM07 runs on an IBM 3031 Computer with MVS operating system using an ADAGE 4370 graphics display terminal with light pen, alphanumeric keyboard emulating IBM 2250-3, and program function keyboard, and an on-line Versatec 8222 electrostatic plotter. The program requires 650K

bytes computer memory and a minimum of 16K bytes (20K preferred) graphics buffer control area. Users with more than one display unit attached to a single graphics control unit may have to reconfigure the buffer memory allocation so that 16K or more memory is available for the COMBIMAN display unit. The Initialization, Anthropometric, Crew Station and Visibility Data Bases reside on a disk drive in a direct access format. The space requirement for each data base depends on the number of members and their complexities. IBM System/360 Operating System Graphic Subroutine Package (GSP) for FORTRAN IV is used to create displays on the CRT. Versatec VERSAPLOT-07 software Plot package is used for on-line plotting. Source modules in File 3 of the distribution tape may have to be changed to accommodate a different plotter.

Other requirements for specific functions are described in the appropriate paragraphs which follow.

## 2.2 AVAILABLE PROCESSING

Functions of Program CBM07 are requested by means of the Program Function Keyboard. The keyboard consists of 32 keys, numbered 0 to 31, whose functions are assigned by program CBM07. When a function is enabled, the appropriate button on the PFK will be lighted. The primary functions for Program CBM07 are shown on the PFK Overlay Mask in Figure 8. The circles in Figure 8 represent the PFKs. Their numbers are shown below each circle. The numbers within the circles represent the subsections where the functions are described in Paragraph 2.2.1. A function is requested by a single, momentary depression of the corresponding PFK.

Once the program is loaded (for instructions on loading, see Paragraph 2.3.1) the prompting area of the screen will display the message "LIGHT-PEN REGRESSION MEMBER" (see Figure 16). The first sequence of steps the user follows should utilize Anthropometry Related functions to generate the man-model. The

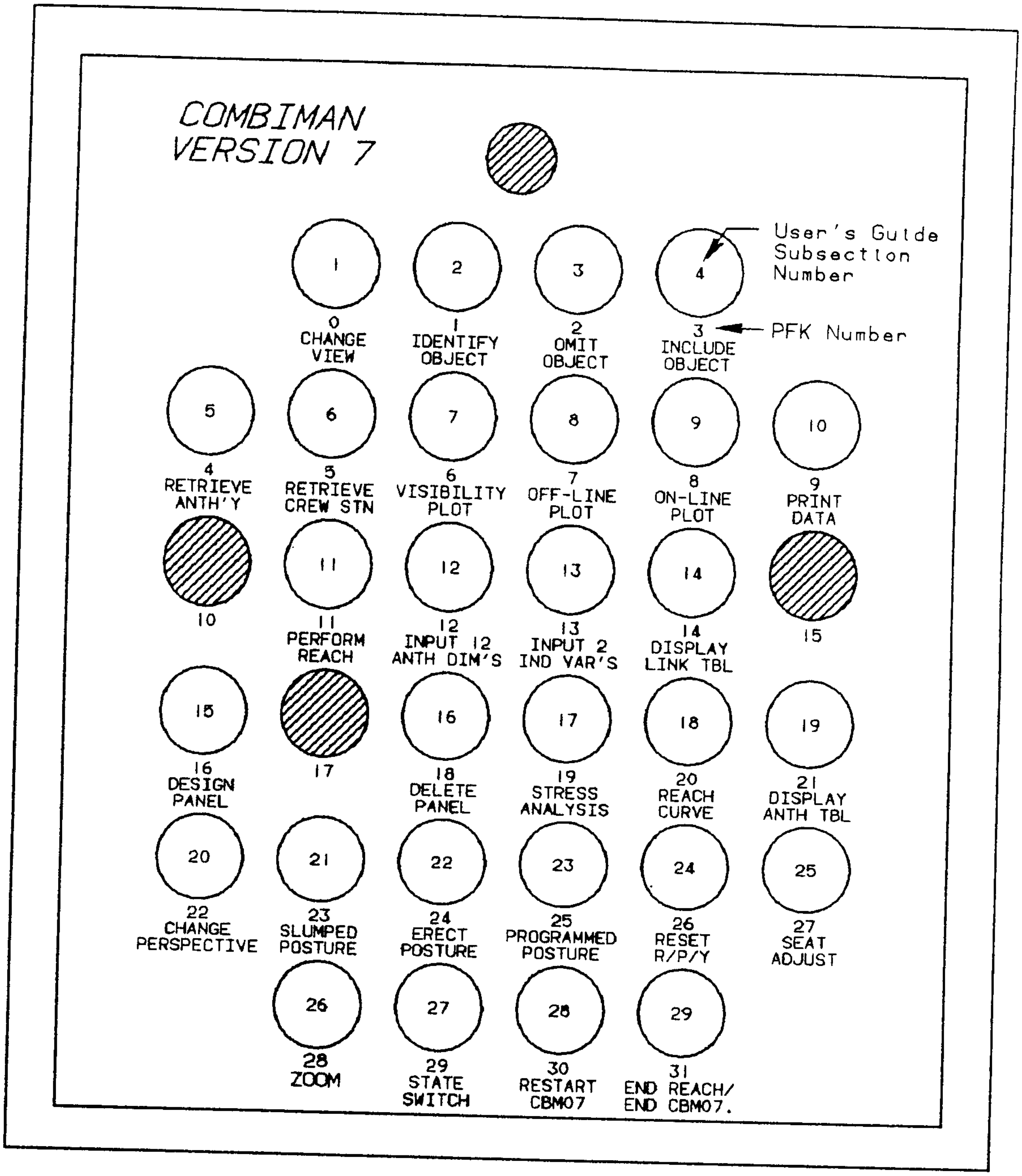



Figure 8. Program Function Keyboard (PFK) Overlay for Program CBM07. The subsection numbers are in Paragraph 2.2, for example, Paragraph 2.2.1 describes the CHANGE VIEW Function, PFK0. Shaded keys are not used or illuminated.

mandatory sequence is shown in Figure 9. The number in each block refers to the paragraph which describes the function.

After the man-model is generated and displayed on the CRT, the user may manipulate the man-model using the Display-Related functions, or may retrieve or develop a crew station using the Crew Station Related functions. The Program Execution Related functions (see Figure 7) are always enabled and may be depressed at any time during the execution of CBM07.

The following paragraphs describe the processing performed by each function as numbered in Figure 8.

### 2.2.1 CHANGE VIEW Function (PFK0)

The CHANGE VIEW function allows users to rotate the man-model and the crew station in the display area of the screen as shown in Figure 5.

Once this function key is selected, the program prompts the user to select either a new view-plane for the display area, or to define a new off-axis orientation of the man-model and crew station. To change the view-plane, the user responds to the message "LIGHT-PEN VIEW CHANGE" by light penning "XY" for a top view, "XZ" for a side view, or "YZ" for a front view of the man-model and crew station. Then the program regenerates the display in the new view-plane. Figures 10, 11, and 12 show the display of COMBIMAN in the A7E-01 cockpit in the XY (top), XZ (side), and YZ (front) view-planes respectively.

If the user responds to the message "LIGHT-PEN VIEW CHANGE" by light penning "OFF-AXIS" in the upper-right corner of the screen, the program prompts users to enter the new roll, pitch, and yaw angles. Angles are specified from the ANKB in degrees by typing the value and depressing the CR key. The default value, 0 degree for these angles, is entered by simply depressing the CR key. The following sequence of replies rotates the man-model and crew station to ROLL = 0 degree, PITCH = -15 degree, and YAW = +15 degree. (Reference Figure 13.)

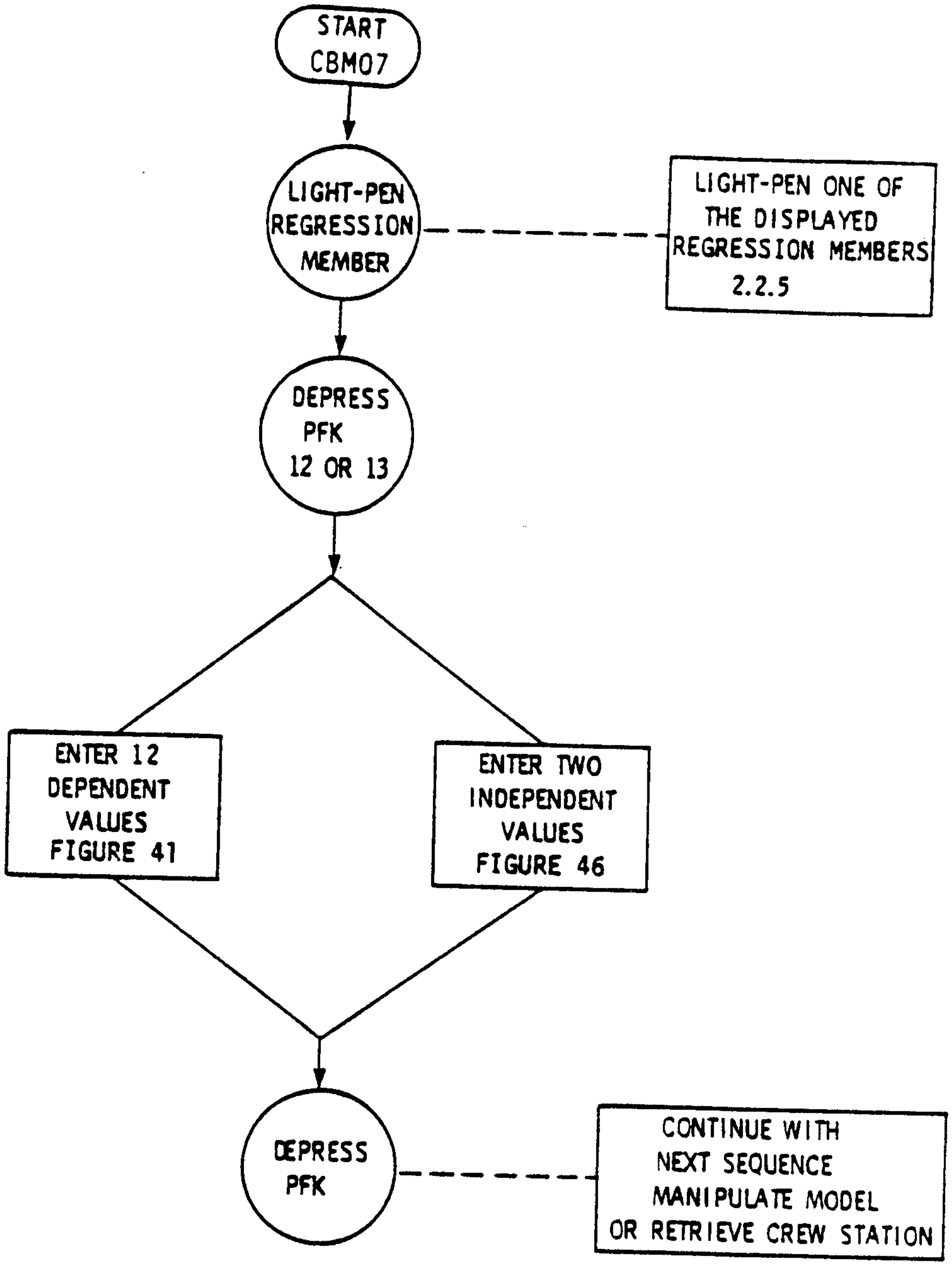



Figure 9. Function Sequence for Generating the Man-Model.

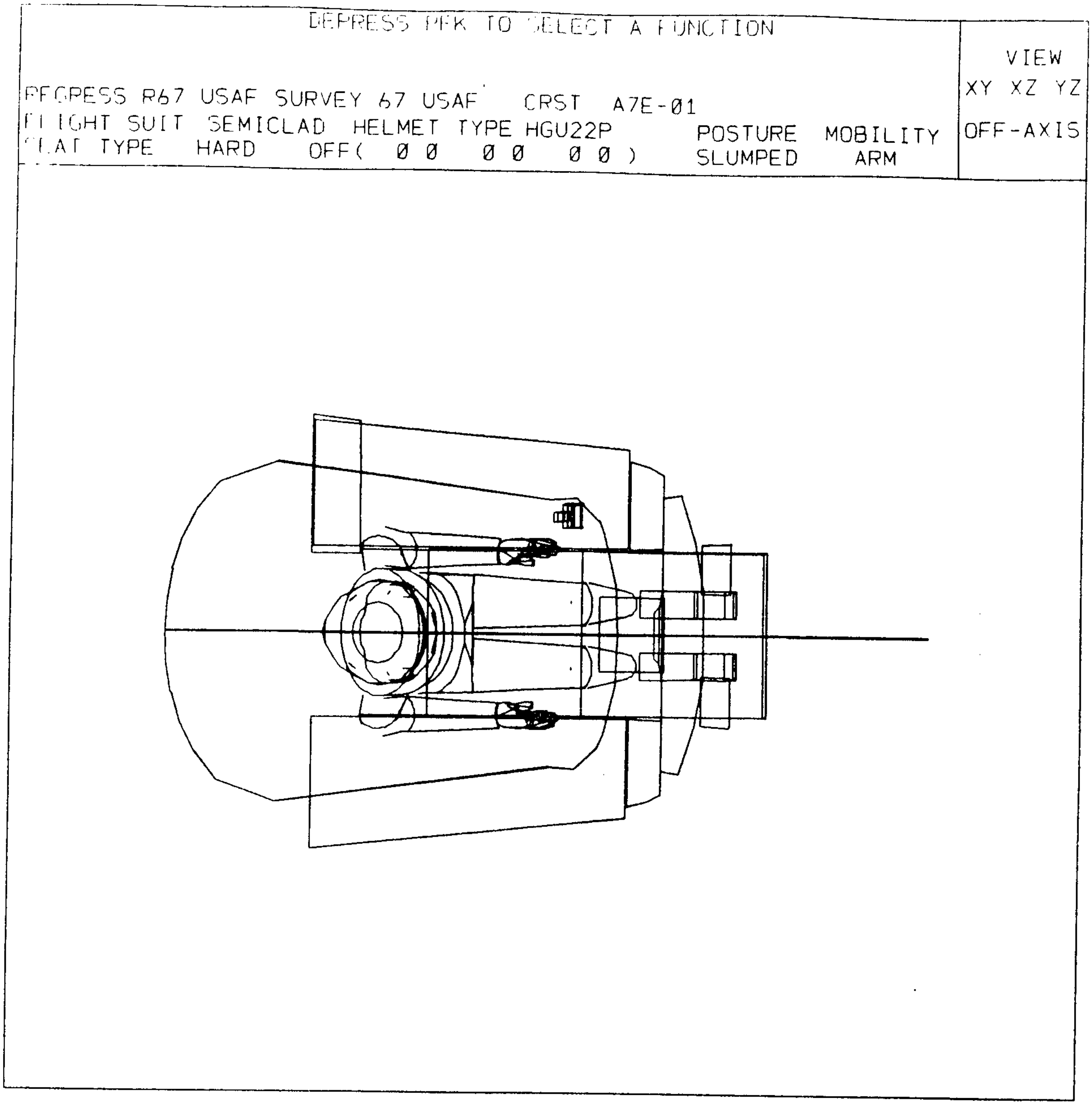



Figure 10. Top View (X-Y Plane) of the Man-Model and a Crew Station.

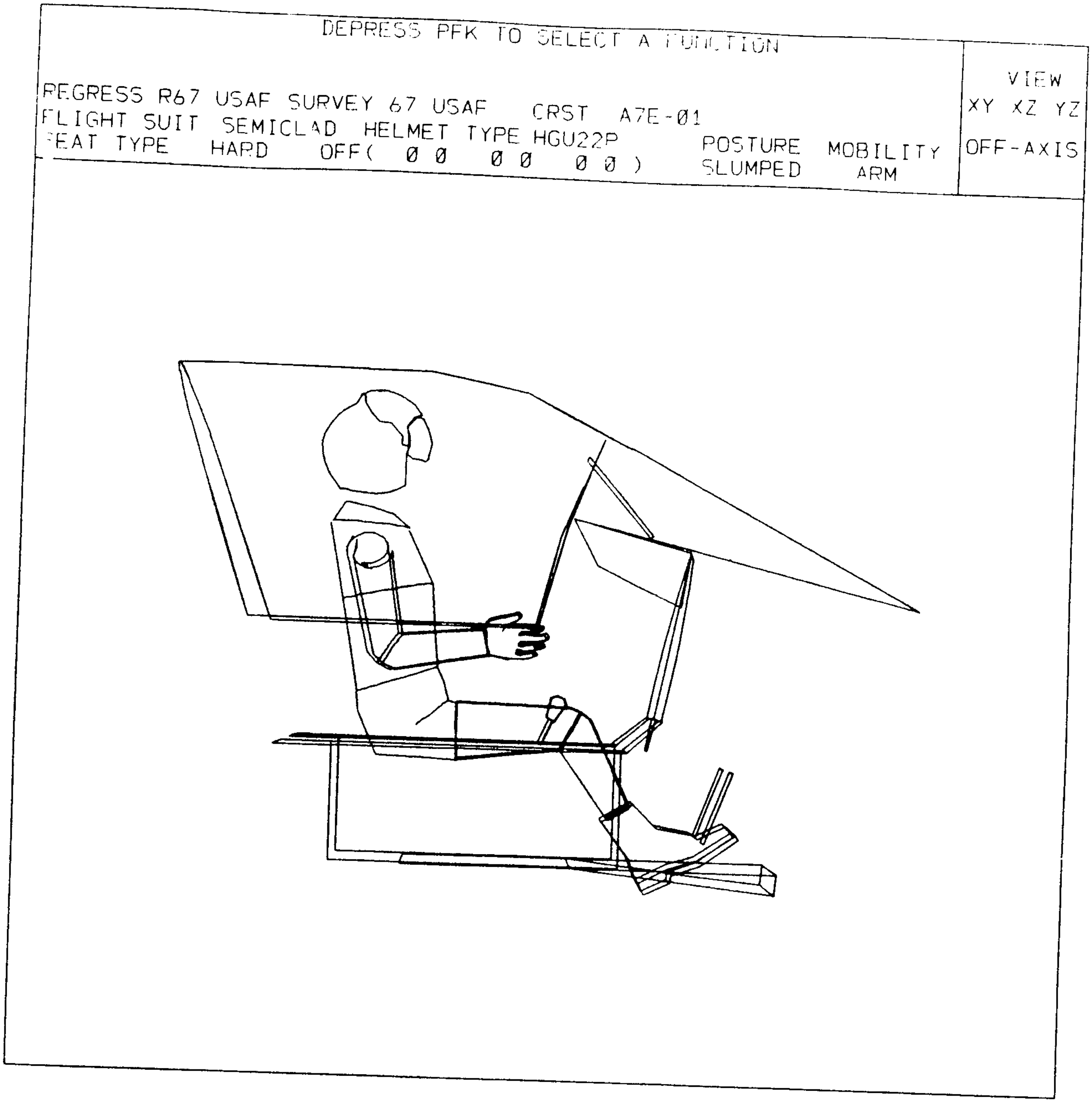



Figure 11. Side View (X-Z Plane of the Man-Model and a Crew Station.

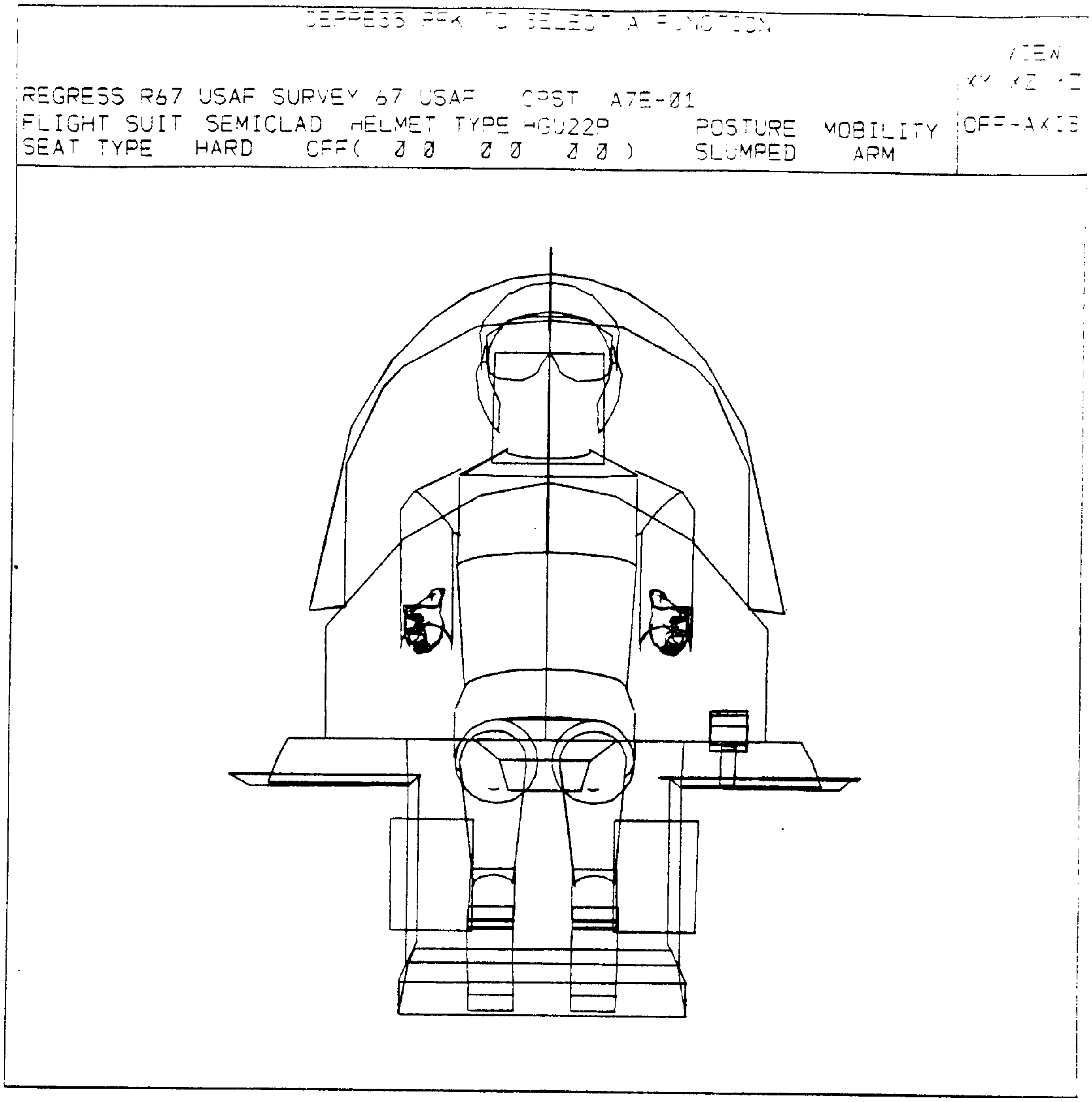



Figure 12. Front View (Y-Z Plane) of the Man-Model and a Crew Station.

STEP 1: CR (Leave ROLL at 0 degrees)

STEP 2: -15 (Change PITCH to -15 degrees)

CR (Enter PITCH = -15 degrees)

STEP 3: +15 (Change YAW to +15 degrees)

CR (Enter YAW = +15 degrees)

Once the YAW angle is entered, the display will be rotated. To clear the off-axis rotation angles, i.e., restore the original view, select CHANGE VIEW, OFF-AXIS, then depress CR key three times.

The directions of rotation are as follows:

| | |
|---|---|
| ROLL (Rotation about the X-axis): | negative=left<br>positive=right |
| PITCH (Rotation about the Y-axis): | negative=nose up<br>positive=nose down |
| YAW (Rotation about the Z-axis): | negative=right<br>positive=left |

### 2.2.2 IDENTIFY OBJECT Function (PFK1)

The IDENTIFY OBJECT function displays identifying information in the Information Area of the CRT for any object (man-model skeletal link or crew station panel) chosen by the user. After depressing PFK1, the message "LIGHT-PEN OBJECT" appears in the Prompting Area of the CRT. The user must then light-pen the object to be identified.

The following three pieces of information for the light-penned object are displayed in the Information Area:

1) The reference number of the object,
2) Reference coordinates for that object, and
3) The 8-character name of the object.

The reference number is an integer, assigned by the program, which identifies a link or a panel. The reference coordinates for the object are the X, Y, and Z coordinates of the distal end point for man-model link, or the X, Y, and Z coordinates of the center of gravity of the selected panel. The 8-character name of the object is either the link name (see Table 3) or the name of the panel as it exists in the Crew Station Data Base. Figure 13 shows the result of an IDENTIFY OBJECT function performed on the HUD (heads up display) in the A7E-01 crew station. The information displayed in the Information Area of the CRT;

```
22      25.55      0.0      28.36      HUDSCRN
```

indicates that its reference number is 22, the coordinates of its center of gravity are X = 25.55, Y = 0.0, and Z = 28.36 and its name is HUDSCRN.

The coordinates of the vertices in COMBIMAN system of coordinates and the message "LIGHT-PEN DISPLAYED COORDINATE OR DEPRESS CR" are displayed in the Display Area.

When the user light-pens the displayed x, y, or z coordinates of a vertex, the selected vertex will be highlighted by a small recognizable appendix which will stay in position until another coordinate is light-penned. To get out of the

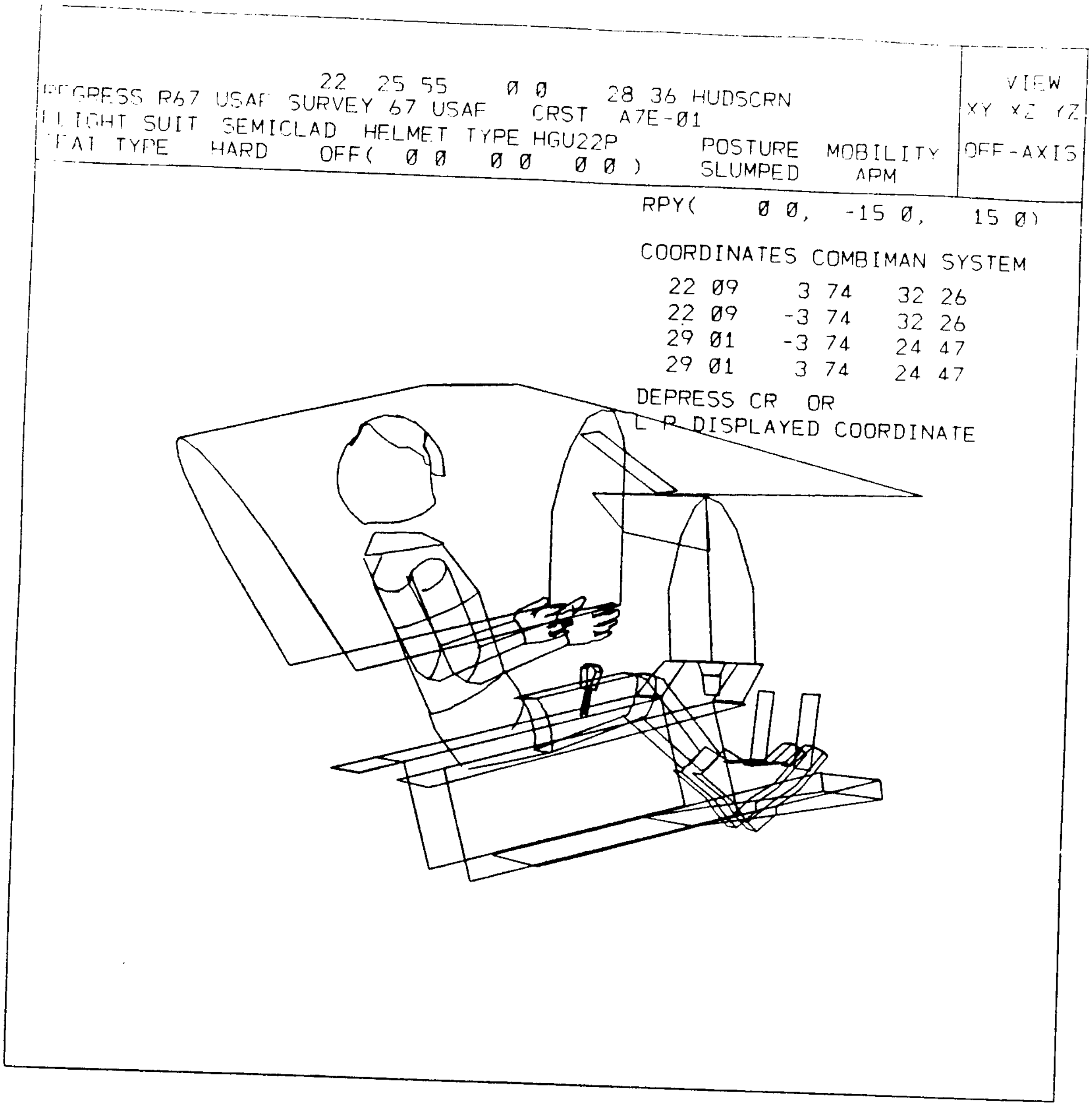



Figure 13. The IDENTIFY OBJECT Function Performed on HUDSCRN (Heads Up Display) of the A7E-01 Crew Station.

function, the user has to depress CR key. If both state switches 23 and 24 are set "ON" the coordinates of the vertices in Aircraft system will be displayed. However, the center of gravity coordinates are always in COMBIMAN system.

The message "CBM010I IDENTIFIED link/panel name" along with distal end coordinates of the identified link or coordinates of all vertices of the identified panel are printed on the message unit.

### 2.2.3 OMIT OBJECT Function (PFK2)

The OMIT OBJECT function temporarily removes a crew station panel or a man-model segment from the display. This function is used to "de-clutter" the display.

On depressing PFK2, the message "LIGHT-PEN OBJECT" appears in the Prompting Area of the CRT. The user must then light-pen the object to be omitted. The program then displays the internal reference number of the object, the X, Y, and Z coordinates of the distal-end point of the selected man-model link or the X, Y, and Z coordinates of the first vertex of the selected panel, and the 8-character name of the object in the Information Area of the CRT. The internal reference number of the object is a unique integer, assigned by the program, which identifies each link and panel. It is the same number that the IDENTIFY OBJECT function displays and must be supplied by the user if the INCLUDE OBJECT function (see Paragraph 2.2.4) is used to redisplay the omitted object. The user may write down these numbers for future reference. Any omitted object can be redisplayed by supplying its internal reference number while performing INCLUDE OBJECT function. Also, all omitted objects are redisplayed whenever the man-model and crew station are regenerated (e.g. during a CHANGE VIEW function or a function which involves use of the cross symbol). Figure 14 shows the message created by OMIT OBJECT function when heads up display screen (HUDSCRN) of A7E-01 crew station is light-penned and Figure 15 shows the display with the HUDSCRN omitted. Note that the message generated by OMIT OBJECT function on CRT display is identical to that of IDENTIFY OBJECT function.

The OMIT is different from the DELETE (PFK18, Paragraph 2.2.17) in that the DELETE is reversed only by reinitiation of the crew station via the RETRIEVE CREW STATION.

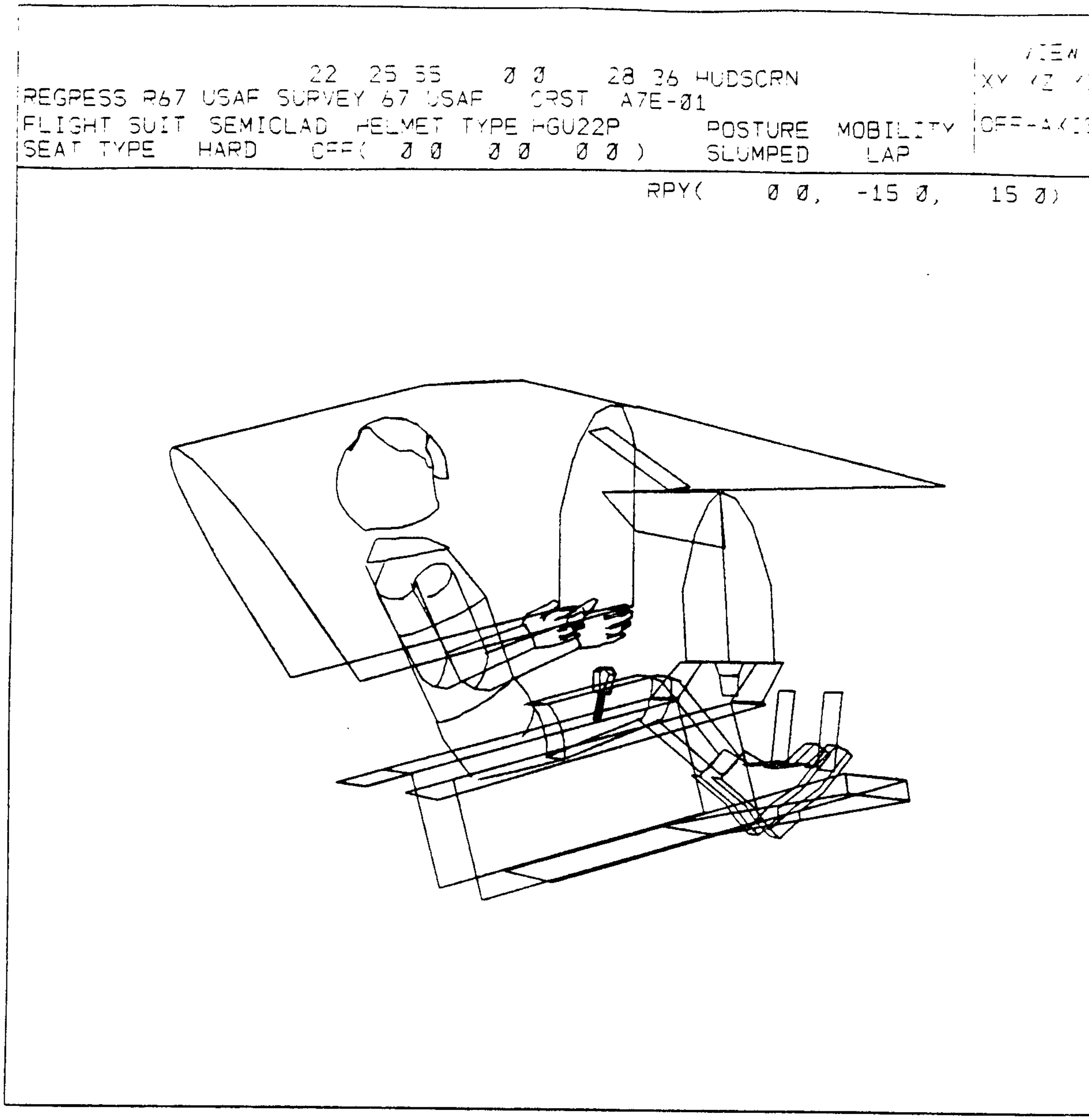



Figure 14. The OMIT OBJECT Function Performed on the HUDSCRN (Heads Up Display) of the A7E-01 Crew Station (Name of Light Penned Object is Displayed).

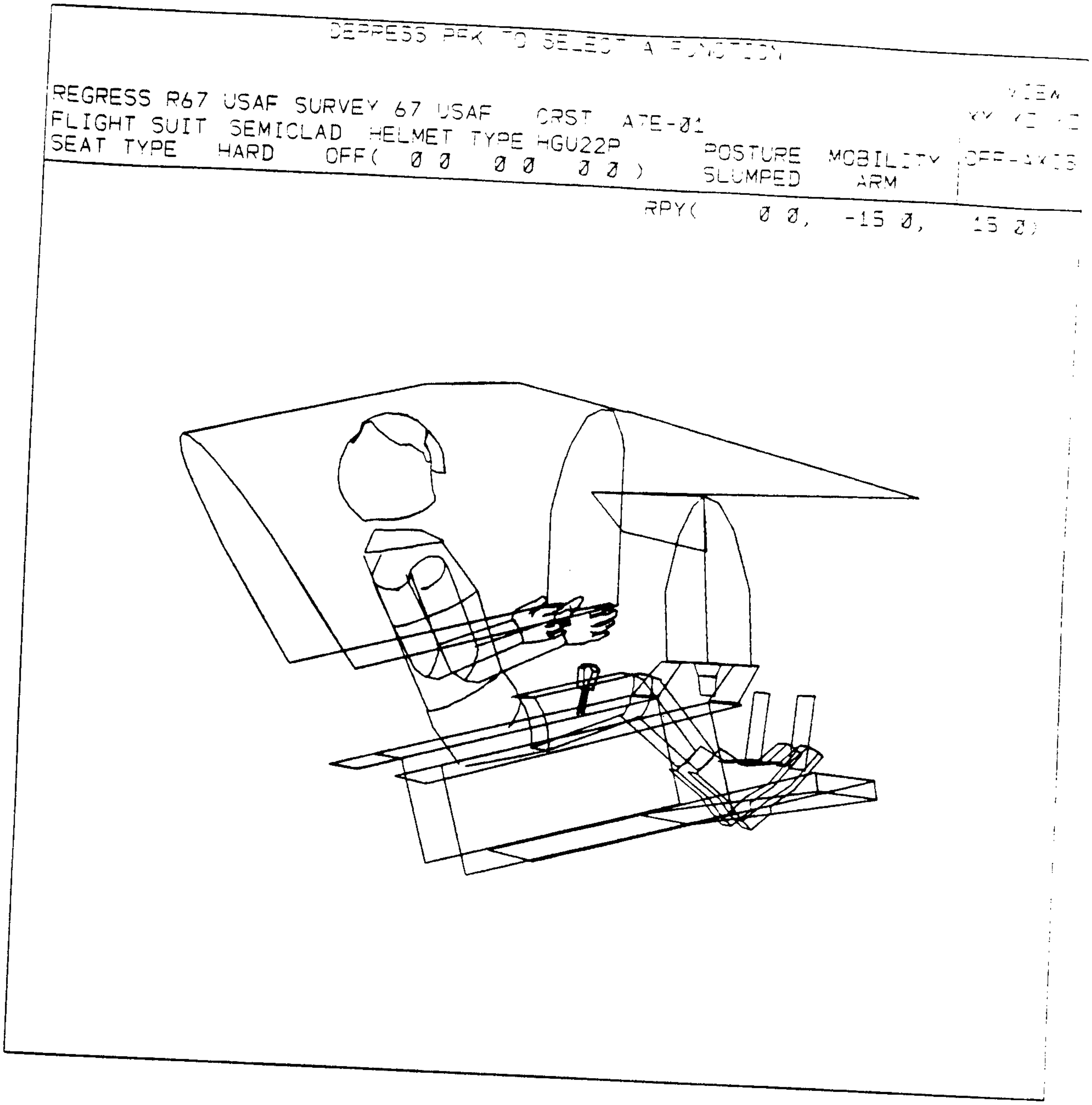



Figure 15. The OMIT OBJECT Function Performed on the HUDSCRN (Heads Up Display) of the A7E-01 Crew Station.

### 2.2.4 INCLUDE OBJECT Function (PFK3)

The INCLUDE OBJECT function redisplays an object that was removed from display screen by OMIT OBJECT function. After depressing PFK3, the message "ENTER OBJECT NUMBER" appears in the Prompting Area of the CRT. The number is entered through ANKB followed by depressing the CR key. The only valid entries for this function are the reference numbers of man-model skeletal links or crew station panels which have previously been deleted by OMIT OBJECT function. The program will keep prompting for a valid internal key number until the user supplies one or depresses the CR key to ignore the function and return to the main program. There are no other messages associated with this function. Depressing PFK3 and entering key Number 62 (HUDSCRN reference number) for the INCLUDE OBJECT function with Figure 15 would cause the heads up display screen to reappear in its original position in the crew station. The man-model and crew station display will once again look like that of Figure 14.

### 2.2.5 RETRIEVE ANTHROPOMETRY Function (PFK4)

This function is the first step in defining the size of the man-model (see Figure 9). The user is first prompted to light-pen the name of a "survey member" from the Anthropometric Data Base. (A detailed explanation of survey members is given in Section 4). Survey membernames are displayed in the column headed "REGRESSION MEMBERS", as shown in Figure 16. To choose the 1967 Survey of the USAF Flying Personnel, the user must light-pen R67 USAF; or to choose the 1970 Survey of U.S. Army Aviators the user must light-pen R70 ARMY*. Once a membername is light-penned, the message "MEMBER membername ACCEPTED" is displayed in the information area of the screen indicating that the means, standard deviations, and percentiles for the anthropometric dimensions are retrieved from the Data Base.

Now the messages "DEPRESS PFK12 TO CHOOSE 12 ANTH VARIABLES" and "DEPRESS PFK13 TO CHOOSE 2 ANTH VARIABLES" also appear on the CRT, and only these two PFKs are illuminated. Here the user selects the dimensioning strategy to define the body size of the man-model. The sequence of steps associated with each of these two function keys is described in Paragraphs 2.2.12 and 2.2.13, respectively. Also see Figures 39 and 45.

*NOTE: Other sets of survey data will be available in future updates of COMBIMAN or the user may create new members using the COMBIMAN Anthropometric Data Base Maintenance program (CBMAM).

LIGHT-PEN SURVEY MEMBER

SURVEY MEMBERS

R67 USAF

R68 AFW

R68 AFWF

R70 ARMY

R77 ARMW

R64 NAVY

Figure 16. Table of Available Regression Member Names - One Member Must Be Selected by Light Penning.

### 2.2.6 RETRIEVE CREW STATION Function (PFK5)

The RETRIEVE CREW STATION function allows the user to retrieve a crew station from the Crew Station Data Base. After PFK5 is depressed, the user is prompted to light-pen a crew station. An example of crew station membernames display is shown in Figure 17. The crew stations without seats are listed in the first column, and the seats are listed in the second column. The third column contains "*ERASE*" and "*NONE*". If a crew station name is light-penned without erasing the previous crew station, both crew stations are superimposed in the display. If "*NONE*" is light-penned, the RETRIEVE CREW STATION function is cancelled.

In order to erase all existing crew stations from the display area, depress PFK5 and light-pen "*ERASE*" and "*NONE*" in that order. When intentionally superimposing two or more crew stations, if the total number of panels exceeds 250, an overflow condition exists, and the message "TOO MANY PANELS/VERTICES * RETRY" appears in the Prompting Area of the CRT. The program then redisplays the crew station membernames as shown in Figure 18. The user may light-pen "*NONE*" to cancel the last entry and relieve the overflow condition.

The A-7 crew station supplied is for example only. The crew station data base must be defined by the user.

LIGHT-PEN CREWSTATION MEMBER

CREW STATION MEMBER

| | | |
|---|---|---|
| A7E-Ø1 | A7--SEAT | *ERASE* |
| A-1ØA | A1Ø-SEAT | |
| B1-P | B1--SEAT | *NONE* |
| B1-CP | SAC-SEAT | |
| B1-OSO | | |
| C13Ø/P&C | | |
| C135PC | | |
| F-16A | | |
| SACL(4Ø) | | |
| SPACEA | | |
| SPACEB | | |
| T-37 | | |
| T-38 | | |
| T38REAR | | |
| YAH64PG | | |
| YAH64CPG | | |

Figure 17. Display of Crew Station Membernames. Only A7E-01 is included in the Crew Station Data Base released with the COMBIMAN system. The user must add other crew stations.

LIGHT-PEN CREWSTATION MEMBER

TOO MANY PANELS/ VERTICES *RETRY

CREW STATION MEMBER

| | | |
|---|---|---|
| A7E-Ø1 | A7--SEAT | *ERASE* |
| A-1ØA | A1Ø-SEAT | |
| B1-P | B1--SEAT | *NONE* |
| B1-CP | SAC-SEAT | |
| B1-OSO | | |
| C13Ø/P&C | | |
| C135PC | | |
| F-16A | | |
| SACL(4Ø) | | |
| SPACEA | | |
| SPACEB | | |
| T-37 | | |
| T-38 | | |
| T38REAR | | |
| YAH64PG | | |
| YAH64CPG | | |

**Figure 18.** Crew Station Membernames Displayed When the Total Number of Panels Exceeds 250.

### 2.2.7 VISIBILITY ANALYSIS Function (PFK6)

The VISIBILITY ANALYSIS function (PFK6) generates and plots a map of the angular line-of-sight (LOS) to objects in the crewstation, or even outside the crewstation if the data base is so defined. MIL-STD-850 requires visual angle maps be made of the crewstation to demonstrate that the pilot has adequate vision through the window. Specifications usually require a minimum downward vision over the nose of the aircraft. Two formats are allowed by MIL-STD-850: rectilinear and Aitoffs. The VISUAL ANALYSIS function in COMBIMAN uses the rectilinear format.

While the MIL-STD-850 requires that the plot of LOS be forward and with respect to the design eye position, the flexibility of COMBIMAN gives the user that and many other options and capabilities:

(1) Eye location defined by movable head. The head can be moved away from forward looking in two ways: first, by changing the angles of the head or neck in the LINK TABLE (PFK14); and second when performing an arm reach analysis with the PERFORM REACH function (PFK11), COMBIMAN's head looks at the point selected as the reach target. So if the user desires the COMBIMAN to look at a specific object, that object can be identified as a point to be reached. Note that the point does not have to be within the acceptable arm reach to accomplish this automatic head repositioning.

(2) Eye location defined by variable body size. The eye location relative to the seat is a function of sitting eye height. The user can adjust this using the RETRIEVE ANTHROPOMETRY function (PFK4).

(3) Eye location modified by seat adjustment. This is a powerful method of adjusting the entire seat-pilot combination. The seat can be adjusted in three dimensions without limit, even to locations outside the immediate crewstation.

(4) Visibility Limit Overlays to show the effect of personnel protective equipment worn on the head, such as helmets, masks, goggles, etc.

(5) Changeable plot size to accomodate the user's needs.

(6) Visibility plots from right eye, left eye, or mid-eye positions. MIL-STD-850 requires visibility plots be made from the mid-eye position equidistant between the two eyes. The COMBIMAN allows plots to be made relative to each eye individually. This is useful for determining the obscuration of window posts, etc. which may limit vision to one but not both eyes. The user can make a plot from the left and right eye reference points, then superimpose them to determine the degree of binocular obscuration.

Because the VISIBILITY ANALYSIS function works from a user created data base, the "crewstation" can be anything the user wishes to define, not just an aircraft cockpit.

Also, objects outside the crewstation can be entered into the data base and plotted. For example, other aircraft in a formation, wings or other structure on the aircraft, a refueling aircraft, a runway the pilot is landing on. All that is required is that these objects be entered into the data base in the appropriate coordinate system.

To use the VISIBILITY ANALYSIS function, the user should first position the eye location as desired, using the methods described above. Then the user calls the function by depressing Function Key 6. The display will be reconfigured with the messages shown in Figure 19. Use the light pen to select the desired options for (1) eye location, (2) vision limit overlays, and (3) plotting option. Selection should be made in that order. The MIDDLE eye location is pre-selected and will appear highlighted. Selecting RIGHT or LEFT will cause the MIDDLE to become dim, and the selected item to be highlighted, indicating that the computer accepted the selection.

VISIBILITY FUNCTION

SELECT EYE LOCATION

MIDDLE RIGHT LEFT

SELECT UP TO FOUR OVERLAYS

(* ERASE *)

HGU-22P & MBU-59 BASE LINE

SELECT OPTION FOR TYPE OF PLOT

PLOT ON SCREEN HARD COPY

SELECT EYE LOCATION AND OVERLAYS AND THEN SELECT PLOT OPTION

**Figure 19. Visibility Function Menu.**

Next, select they desired vision limit overlays. If any are highlighted that are not desired, simply select ERASE and all choices will be de-selected. You need not select any if you do not want to, just proceed to the next step. You may select up to four of the vision limit overlays from the list. If you select more than four, the first one selected will become dim, indicating that it was de-selected. The BASELINE overlay represents the field of binocular peripheral vision, unobstructed by any head gear. The HGU-22P & MBU-5 represents the visibility obscuration of the standard Air Force helmet and oxygen mask. (NOTE: the user can add up to 12 more visibility limits using the data base maintenance utility program described in section 6 of this report.)

The last step is the selection of the plot media. If you wish to see the plot on the CRT screen, simply light-pen PLOT ON SCREEN. If you wish to get a hard copy plot on your graphics plotter, select HARD COPY. As soon as you select one of these, the function begins to execute, and cannot be stopped until it has completed the desired plot. If you are not sure, or if it will be a while before the hard copy plot is available, you may wish to view the plot on the screen first, just to make sure that it is what you want, then repeat the process, selecting the hard copy the second time.

If the user wishes to change the size of the HARD COPY plot, set state switch 19 "ON", a message "ENTER SCALE FACTOR FOR VISIBILITY PLOT" appears and the user has to enter a value not greater than 2.5 through the ANKB followed by depressing the "CR" key. Now the message "PLOTTING" is displayed and the plot is generated on the Versatec plotter.* For the default scale factor 1.0, the size of the visibility plot is 0.04 inch per degree or 7.2 x 14.4 inches. If the user chooses a scale

*Subroutine CBMVSI has to be modified to get plots on a different plotter.

factor 0.5, the plot size will be 3.6 x 7.2 inches. The limiting value of the scale factor 2.5 is intended to get the entire plot without break on the 22 inch Versatec plotter. The plot will be 0.1 inch per degree, as specified by MIL-STD-850, or 18 x 36 inches.

The routines which perform the plotting use the coordinates which define the vector from the mid-head position to mid-eye position (Link 8) to calculate the angular orientation of the head (head aim point) from the horizontal and vertical directions. If the head is facing forward and looking straight ahead, the orientation of his head would be 0 degree from horizontal and 0 degree from vertical.

Figure 20 shows a sample visibility plot of a canopy clearline for a single seat aircraft. For this example, we chose the man-model to be 50th percentile weight and sitting height from the 1967 USAF Survey, seat erect, and looking straight ahead.

The two contours superimposed on the plot define the limits of various visual fields. The field defined with the character "*" is the field of vision with the USAF HGU-22/P helmet and MBU-5/P oxygen mask. The field defined with the character "Ø" is the field of peripheral vision with the eyes caged with respect to the head. The symbol "O" is the aim point of the head (and eyes if the eyes are caged forward with respect to the head). The vision limits are generated with respect to the angle of sight from the head aim point (end point of Link 8).

In addition to generating a hard copy plot, if state switch 20 is set "ON" (see Table 4) the routine also calculates and prints a cross-reference listing of the three-dimensional coordinates of the objects plotted in five degree azimuth increments from -180 degrees from horizontal line of sight to +180 degrees for each panel and/or contour in the visibility member. This listing is a handy reference to the crewstation drawings. The coordinates are given in both original

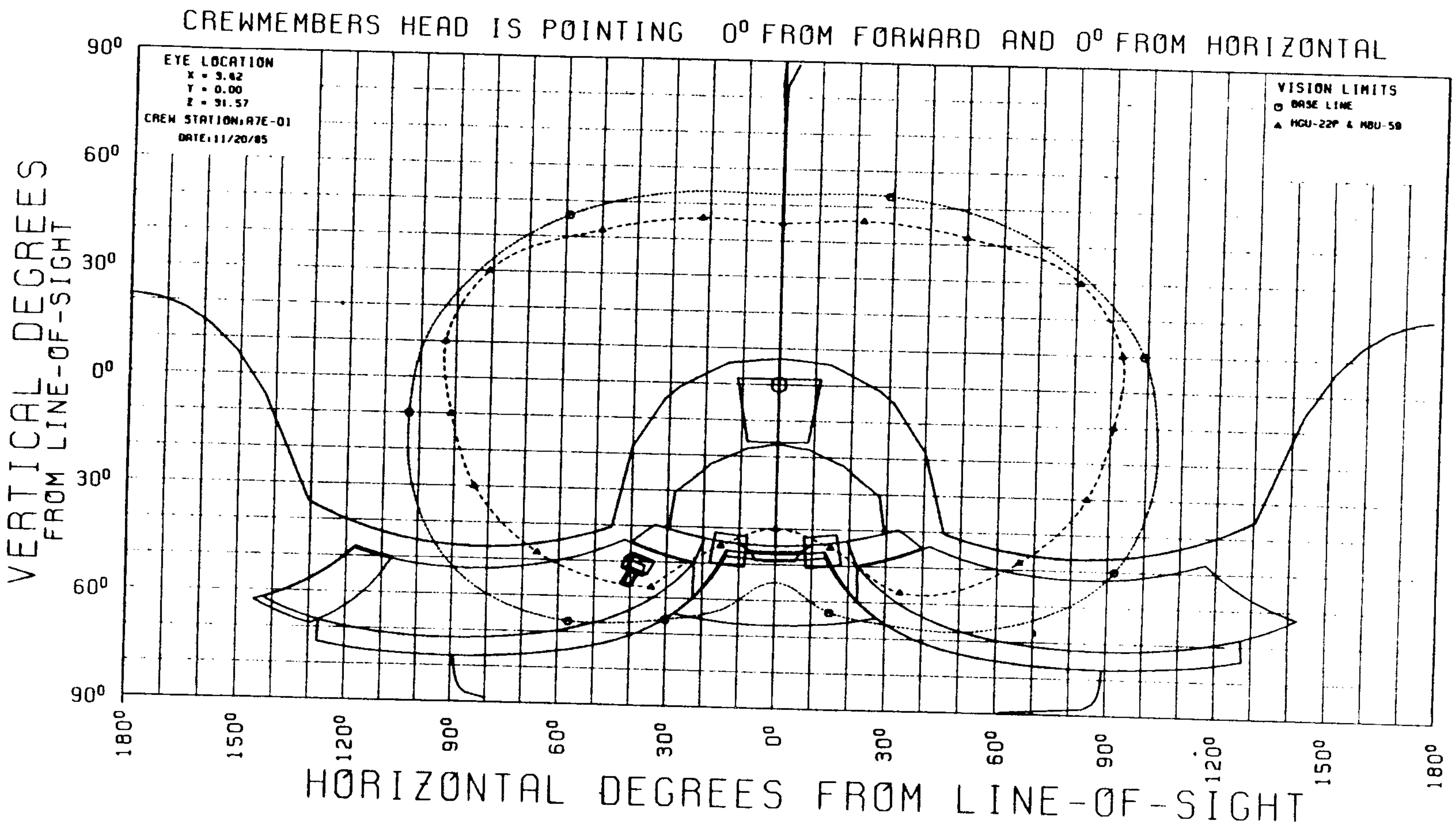



Figure 20. Visibility Plot.

user-supplied system of coordinates and the Neutral Seat Reference Point (NSRP) system of coordinates are if both are available (see Paragraph 5.3.2.1). The listing also gives the coordinates of the eye location of the man-model. Figure 21 shows a part of the coordinate data for the plot in Figure 20.

VISIBILITY MEMBER NAME: A7E-Ø1

EYE LOCATION IN SRP SYSTEM ( 3.41, Ø.Ø , 31.86)

LINE-OF-SIGHT IN DEGREES ( Ø, Ø)

VISIBILITY PLOT DATA FOR CONTOUR: LMIPAN

| LINE-OF-SIGHT ANGLES HORIZ. | VERT. | COMBIMAN COORDINATES X | Y | Z |
|---|---|---|---|---|
| Ø | -45 | 26.111 | Ø.Ø | -26.134 |
| 29 | -41 | 26.111 | 14.75Ø | -26.134 |
| 28 | -31 | 27.766 | 14.76Ø | -18.699 |
| 18 | -23 | 29.Ø68 | 9.57Ø | -12.8ØØ |
| 9 | -18 | 29.7Ø2 | 4.5ØØ | -9.965 |
| Ø | -17 | 29.71Ø | Ø.Ø | -9.1Ø5 |

VISIBILITY PLOT DATA FOR CONTOUR: RMIPAN

| LINE-OF-SIGHT ANGLES HORIZ. | VERT. | COMBIMAN COORDINATES X | Y | Z |
|---|---|---|---|---|
| Ø | -45 | 26.111 | Ø.Ø | -26.134 |
| -29 | -41 | 26.111 | -14.75Ø | -26.134 |
| -28 | -31 | 27.766 | -14.75Ø | -18.699 |
| -18 | -23 | 29.Ø68 | -9.57Ø | -12.8ØØ |
| -9 | -18 | 29.7Ø2 | -4.5ØØ | -9.965 |
| Ø | -17 | 29.71Ø | Ø.Ø | -9.1Ø5 |

VISIBILITY PLOT DATA FOR CONTOUR: FWDLHCON

| LINE-OF-SIGHT ANGLES HORIZ. | VERT. | COMBIMAN COORDINATES X | Y | Z |
|---|---|---|---|---|
| 22 | -5Ø | 22.565 | 9.25Ø | -29.164 |
| 4Ø | -45 | 22.565 | 18.76Ø | -29.164 |
| 36 | -42 | 24.66Ø | 18.Ø1Ø | -27.382 |
| 33 | -4Ø | 26.161 | 17.18Ø | -26.145 |
| 2Ø | -43 | 26.161 | 9.28Ø | -26.145 |

VISIBILITY PLOT DATA FOR CONTOUR: LHCON

| LINE-OF-SIGHT ANGLES HORIZ. | VERT. | COMBIMAN COORDINATES X | Y | Z |
|---|---|---|---|---|
| 22 | -5Ø | 22.424 | 9.25Ø | -29.282 |
| 143 | -62 | -12.Ø65 | 9.25Ø | -28.982 |
| 118 | -48 | -12.Ø65 | 23.Ø1Ø | -28.982 |
| 42 | -44 | 22.423 | 2Ø.ØØØ | -29.292 |

VISIBILITY PLOT DATA FOR CONTOUR: AFTLHCON

| LINE-OF-SIGHT ANGLES HORIZ. | VERT. | COMBIMAN COORDINATES X | Y | Z |
|---|---|---|---|---|
| 13Ø | -69 | -7.Ø15 | 8.5ØØ | -29.Ø26 |
| 145 | -63 | -12.195 | 8.5ØØ | -28.98Ø |
| 117 | -48 | -12.195 | 23.62Ø | -28.98Ø |
| 1Ø7 | -5Ø | -7.Ø65 | 23.ØØØ | -29.Ø35 |

Figure 21. Coordinate Data Plots.

### 2.2.8 OFF-LINE PLOT COMBIMAN Function (PFK7)

The OFF-LINE PLOT COMBIMAN function saves the coordinate data of the man-model and crew station currently displayed for later use to generate an off-line plot. The prompting and informational messages for this function and the necessary replies are identical to those for the ON-LINE PLOT COMBIMAN function described in Paragraph 2.2.9.

After depressing the OFF-LINE PLOT function key (PFK7) the message "DO YOU WANT PERSPECTIVE PLOT? ENTER Y/N" is displayed in the prompting Area. Here the user has the option to select a perspective or nonperspective plot. A perspective plot shows the man-model and crew station with infinite perspective (see display on the CRT with state switch four 'OFF'). In this display objects farther from the view appear smaller. Nonperspective plot does not show any perspective (see display on the CRT with state switch four 'ON'). In this display objects are the same size regardless of the distance from the viewer. The user must type "Y" or "YES" for a perspective plot, or "N" or "NO" for a nonperspective plot using the ANKB, and must depress CR key.

The program then displays the message "ENTER PLOT SCALE FACTOR" in the Prompting Area of the CRT. For a perspective plot, a scale factor of 1.0 produces a 10 x 10 inch plot identical to the size of the Display Area on the CRT. For a nonperspective plot, the scale factor is applied to full-scale data. The user must consider the size restrictions of the available plotter when specifying the scale factor. For example, a 1.0 scale perspective plot is about the same size as a 0.10 scale nonperspective plot.

To enter the scale factor, the decimal value is typed using the ANKB as shown in Figure 22 and is followed by the ALT-CODE/5 sequence. When a valid scale factor (greater than 0.0) is entered, the user will be prompted to enter comments at the bottom of the display area (see Figure 23). Now the user may type up to 10 lines of 60 characters each, each line followed by depressing the "CR" key. To terminate comments enter a blank line. Now the message "PLOTTING" appears in the Informational Area of the CRT as shown in Figure 24 and the data are written to a disk file for later use as described in Section 3.

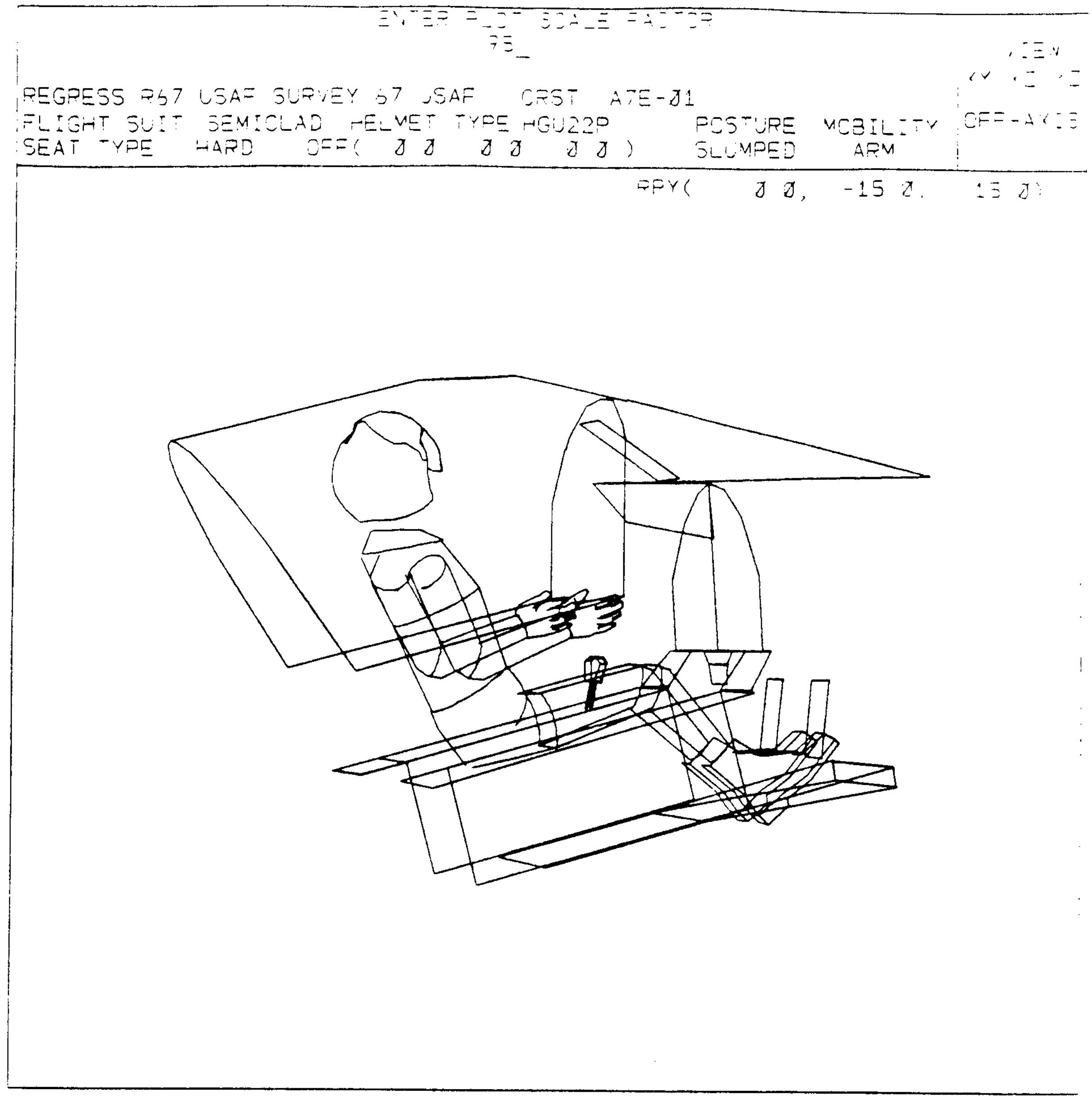



Figure 22. PLOT Function. Enter Plot Scale Factor.

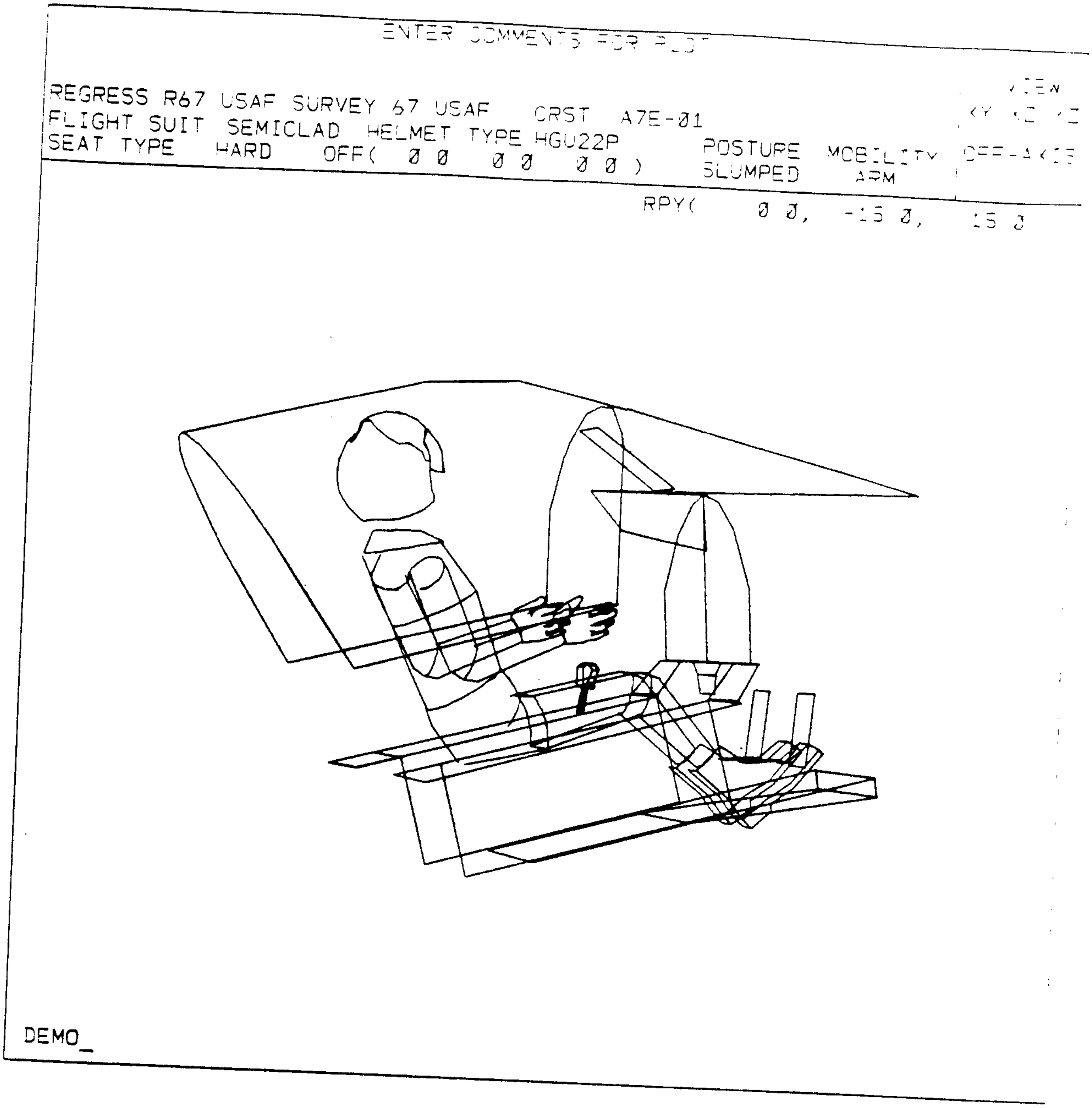



Figure 23. PLOT Function. Enter Comments for Plot.

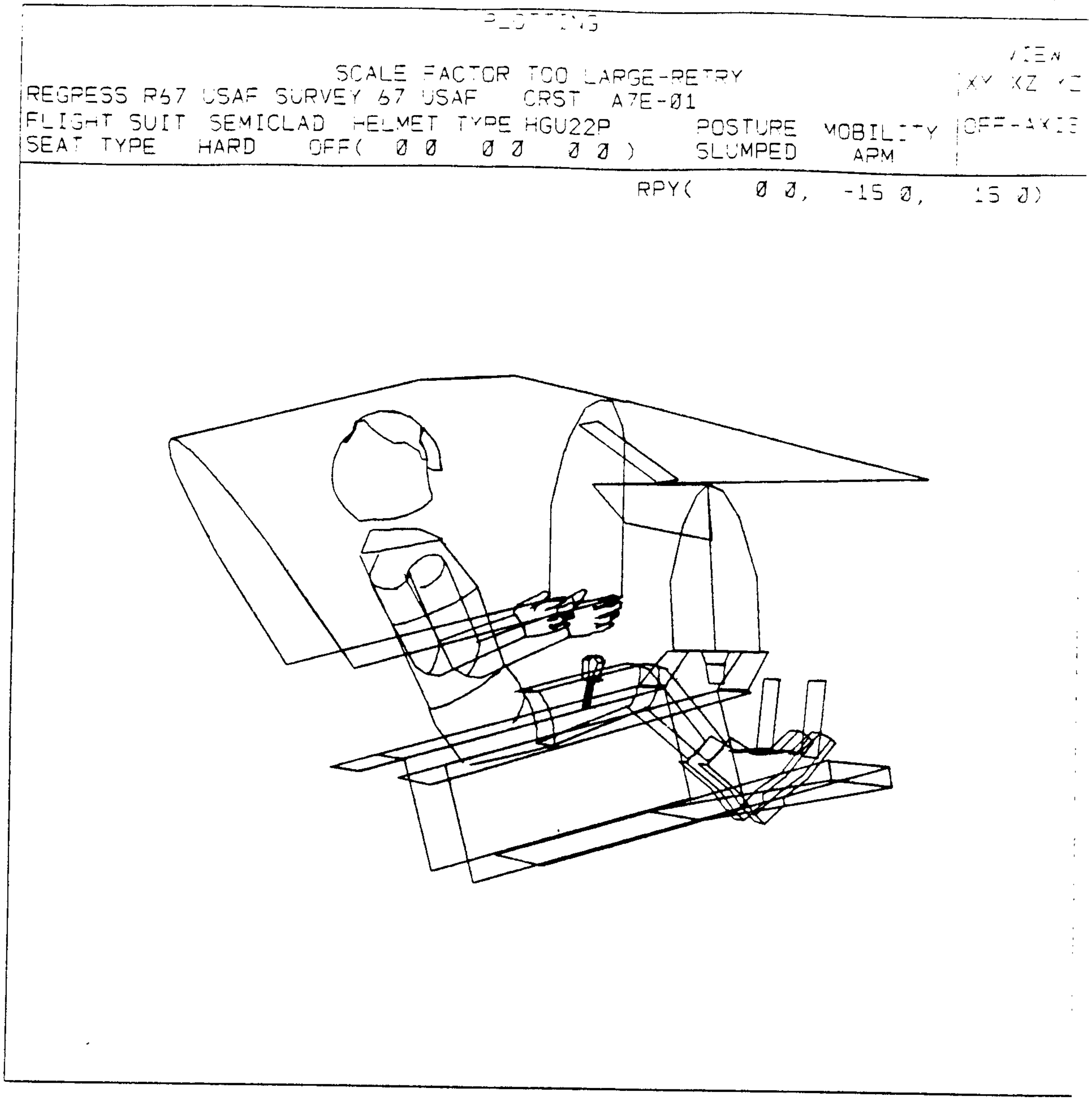



Figure 24. PLOT Function. Message "PLOTTING" displayed when plotting is done on the Versatec plotter.

### 2.2.9 ON-LINE PLOT COMBIMAN Function (PFK8)

The ON-LINE PLOT COMBIMAN function generates immediate on-line plots of the man-model and crew station configuration currently shown in the Display Area of the screen. Otherwise, this function is identical to the OFF-LINE PLOT function. After depressing the ON-LINE PLOT function key (PFK8), the user has the option of selecting a perspective or a nonperspective plot (see Paragraph 2.2.8). The program displays the message 'DO YOU WANT PERSPECTIVE PLOT? ENTER Y/N" in the Prompting Area of the CRT. (See Paragraph 2.2.8 for definitions.) The user must respond "Y" or "YES" for a perspective plot, or "N" or "NO" for a nonperspective plot, from the ANKB.

The program then displays the message "ENTER PLOT SCALE FACTOR" in the Prompting Area of the CRT (see Paragraph 2.2.8). To enter the scale factor, the decimal value is typed using the ANKB and is followed by a carriage return (see Figure 22). When a valid scale factor (see Paragraph 2.2.8) is entered the program displays the message "ENTER COMMENTS" in the Information Area of the CRT (see Figure 23). The cursor shows up at the lower left hand side of the display and the user may type up to 10 comment lines of 60 characters per line. After each comment line, depress "CR" key. To terminate comments enter a blank line. Now the message "PLOTTING" is displayed in the Information Area of the CRT (see Figure 24), and a hard copy plot is generated. Note that the scale factor is applied to the display image size for perspective plots, and to the full-scale coordinates for nonperspective plots. A sample on-line perspective plot is shown in Figure 25.

CAUTION: This function requires an on-line plotter. If the user's facility does not have an on-line plotter, use alternate program CBM7NOPL as discussed at the beginning of Section 2. CBM7NOPL has this Function Key disabled, but otherwise is identical to CBM07.

SURVEY:67 USAF  CREWSTATION:A7E-01  DATE: 10/23/85
VIEW-PLANE: OFF AXIS  ROLL:0.0  PITCH:-15.0  YAW:15.0
PERSPECTIVE PLOT  SCALE:0.85

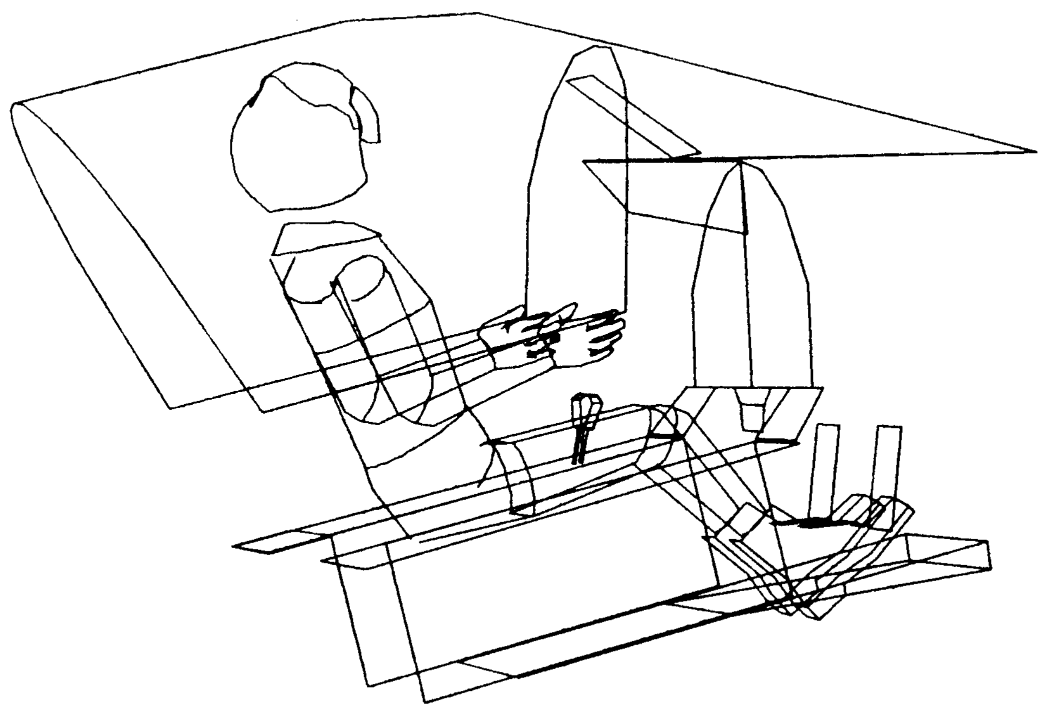


Figure 25. Output for COMBIMAN PLOT Function.

### 2.2.10 PRINT DATA Function (PFK9)

The PRINT DATA function saves the data pertinent to the displayed image at the time PFK9 is depressed. These data are accumulated and printed at the end of the session. This gives the user a way to record for future reference the different configurations created during the interactive session.

The PRINT DATA function prints man-model and crew station data. The man-model data consist of, for each link, the X, Y, and Z coordinates of the distal end of each link, the transformation angles for each link, and the enfleshment semi-axes lengths.

Data for the displayed crew station panels consist of the name, type, and X, Y, and Z coordinates of all the vertices. The coordinates of each control on the displayed crew station together with its name and name of the panel it is located on, if any, are also printed. An example of the man-model data output generated by the PRINT DATA function is shown in Figure 26.

COMBIMAN LINK DATA

SURVEY DATA OF 67 USAF

| NO. | NAME | DISTAL END X | DISTAL END Y | DISTAL END Z | JOINT ANGLES PHI | JOINT ANGLES THETA | JOINT ANGLES PSI | SEMI AXIS LENGTHS ALPHA | SEMI AXIS LENGTHS BETA | SEMI AXIS LENGTHS GAMMA |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | SRP | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1 | SRP-MHIP | 4.64 | 0.0 | 3.41 | 0.0 | 53.70 | 0.0 | 4.53 | 7.41 | 4.58 |
| 2 | MHIP-L34 | 2.82 | 0.0 | 8.26 | 0.0 | -74.20 | 0.0 | 4.37 | 6.07 | 4.37 |
| 3 | CHEST | 0.26 | 0.0 | 17.37 | 0.0 | 4.80 | 0.0 | 4.81 | 6.43 | 4.81 |
| 4 | T89-T1 | -0.46 | 0.0 | 24.82 | 0.0 | 10.00 | 0.0 | 3.61 | 8.01 | 3.61 |
| 5 | NECK | 0.80 | 0.0 | 29.87 | 0.0 | 20.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 6 | NECK-MHD | 0.80 | 0.0 | 31.28 | 0.0 | -14.30 | 0.0 | 3.83 | 3.04 | 4.47 |
| 7 | MHD-MEYE | 4.14 | 0.0 | 31.28 | 0.0 | 90.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 8 | MEYE-REY | 4.14 | -1.25 | 31.28 | -90.00 | 90.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 9 | MEYE-LEY | 4.14 | 1.25 | 31.28 | 90.00 | 90.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 10 | T1-MSS | 2.56 | 0.0 | 23.76 | 0.0 | 115.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11 | MSS-RSS | 2.56 | -1.00 | 23.76 | -90.00 | 90.00 | 29.30 | 0.0 | 0.0 | 0.0 |
| 12 | RSS-RSLD | -1.14 | -8.01 | 21.44 | 22.00 | 31.90 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13 | RSLDR | -1.14 | -8.01 | 21.44 | 0.0 | -31.90 | -112.00 | 2.31 | 2.30 | 2.07 |
| 14 | RUPARM | 0.76 | -8.01 | 10.68 | 0.0 | -90.00 | -90.00 | 1.73 | 1.73 | 1.73 |
| 15 | RLWARM | 11.16 | -8.01 | 12.51 | 0.0 | 90.00 | 0.0 | 1.10 | 1.10 | 1.10 |
| 16 | RGRIP | 13.13 | -8.01 | 12.86 | 0.0 | 0.0 | 0.0 | 2.01 | 0.54 | 3.76 |
| 17 | RFNRCH | 15.76 | -8.01 | 13.33 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 18 | RFNGRTIP | 18.57 | -8.01 | 13.82 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 19 | MSS-LSS | 2.56 | 1.00 | 23.76 | 90.00 | 90.00 | -29.30 | 0.0 | 0.0 | 0.0 |
| 20 | LSS-LSLD | -1.14 | 8.01 | 21.44 | -22.00 | 31.90 | 0.0 | 0.0 | 0.0 | 0.0 |
| 21 | LSLDR | -1.14 | 8.01 | 21.44 | 0.0 | -31.90 | 112.00 | 2.31 | 2.30 | 2.07 |
| 22 | LUPARM | 0.76 | 8.01 | 10.68 | 0.0 | -90.00 | 90.00 | 1.73 | 1.73 | 1.73 |
| 23 | LLWRARM | 11.16 | 8.01 | 12.51 | 0.0 | 90.00 | 0.0 | 1.10 | 1.10 | 1.10 |
| 24 | LGRIP | 13.13 | 8.01 | 12.86 | 0.0 | 0.0 | 0.0 | 2.01 | 0.54 | 3.76 |
| 25 | LFNRCH | 15.76 | 8.01 | 13.33 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 26 | LFNGRTIP | 18.57 | 8.01 | 13.82 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 27 | MHIP-RHP | 4.64 | -3.43 | 3.41 | -90.00 | 90.00 | 53.70 | 3.24 | 3.24 | 4.10 |
| 28 | RUPRLEG | 21.53 | -3.43 | 5.48 | 97.00 | 90.00 | -90.00 | 2.15 | 2.16 | 2.16 |
| 29 | RLWRLEG | 31.25 | -3.43 | -7.42 | 0.0 | 60.00 | 0.0 | 1.40 | 1.40 | 1.40 |
| 30 | RANKLE | 32.56 | -3.43 | -9.18 | 0.0 | 0.0 | 0.0 | 5.32 | 1.92 | 1.28 |
| 31 | MHIP-LHP | 4.64 | 3.43 | 3.41 | 90.00 | 90.00 | -53.70 | 3.24 | 3.24 | 4.10 |
| 32 | LUPRLEG | 21.53 | 3.43 | 5.48 | -97.00 | 90.00 | 90.00 | 2.15 | 2.16 | 2.16 |
| 33 | LLWRLEG | 31.25 | 3.43 | -7.42 | 0.0 | 60.00 | 0.0 | 1.40 | 1.40 | 1.40 |
| 34 | LANKLE | 32.56 | 3.43 | -9.18 | 0.0 | 0.0 | 0.0 | 5.32 | 1.92 | 1.28 |

Figure 26. Output for COMBIMAN PRINT Function.

### 2.2.11 PERFORM REACH ANALYSIS Function (PFK11)

The REACH ANALYSIS function of the COMBIMAN allows the user to evaluate the aircrew member's ability to reach and operate controls as a function of body size, clothing type, restraint type, and type of control. The function produces a single reach to a control location which the user must specify. Given the mobility limits which the user defines, the function causes the COMBIMAN to reach toward that location with realistic joint mobility. If the COMBIMAN is unable to perform the reach because of limited body size or clothing or harness restraints, a "miss distance" displays the remaining distance between the extended grip and the control location. This function differs from the REACH CURVE ANALYSIS (PFK20) in that the reach curve computes the maximum reach envelope in a plane (control panel) which must already be defined as a part of the crew station. The REACH ANALYSIS is a reach to any point the user cares to specify. Interference is not computed, but the user can easily identify any interferences with the reach by inspecting the displayed image, rotating it with the CHANGE VIEW function if necessary.

The clothing types are a semiclad baseline condition plus common USAF flight clothing combinations: summer flying suit; summer flying suit with survival vest; winter flying suit; winter flying suit with survival vest; winter flying suit with vest, jacket, and flotation vest; and chemical defense ensemble.

There are three harness restraint conditions: LAP (corresponding to a lap belt with shoulder harness unlocked), SHOULDER (corresponding to a locked shoulder harness with only arm and shoulder movement allowed, but no torso movement) and ARM (corresponding to arm-only movement, as with a comfortable, unstrained reach).

Four different types of controls are typically found in seated crew stations and the COMBIMAN can evaluate all four of these. The four types of reaches and controls are fingertip reach for operating pushbuttons, functional reach for

operating rotary knobs, grip center reach for operating hand-grips, and leg reach for foot pedals.

Before performing a reach analysis, the user should reconsider how the anthropometry of the COMBIMAN was defined and, if necessary, the user should redefine it. If the user is evaluating reach to hand operated controls, the ARM LENGTH variable under the two variable method of body size definition in Paragraphs 2.2.5 RETRIEVE ANTHROPOMETRY and 2.2.13 INPUT TWO INDEPENDENT VARIABLES should be used. If the user is evaluating ability to reach and operate foot controls, the LEG LENGTH variable should be used.

To use the REACH ANALYSIS function, the user must tell the computer what clothing type to use, what type of harness restraint is present, which limb is performing the reach, what type of grip to use (corresponding to the type of control being reached) and the location of the control. The user specifies the location of a control by moving a slewable cursor over the screen to the appropriate point in the workplace or crewstation. The user must also consider the displacement of the control when selecting the control location. Sometimes, the reach analysis should consider the "deflected" control location rather than the current or neutral control location. Indeed, the user may wish to analyze multiple locations for controls having a large or multiaxis displacement.

The program can simulate a "both" arm reach. The is one limitation on this, however. The reach with the second arm is limited to ARM or SHOULDER type of reach. Whatever torso movement occurs on the reach with the first arm will be frozen for the second arm reach.

The sequence of PERFORM REACH ANALYSIS is shown in Figure 27. First, the program prompts the user to light-pen REACH MOBILITY, as shown in Figure 28. There are three choices:

ARM selection - allows arm movement only with the shoulder and torso fixed.

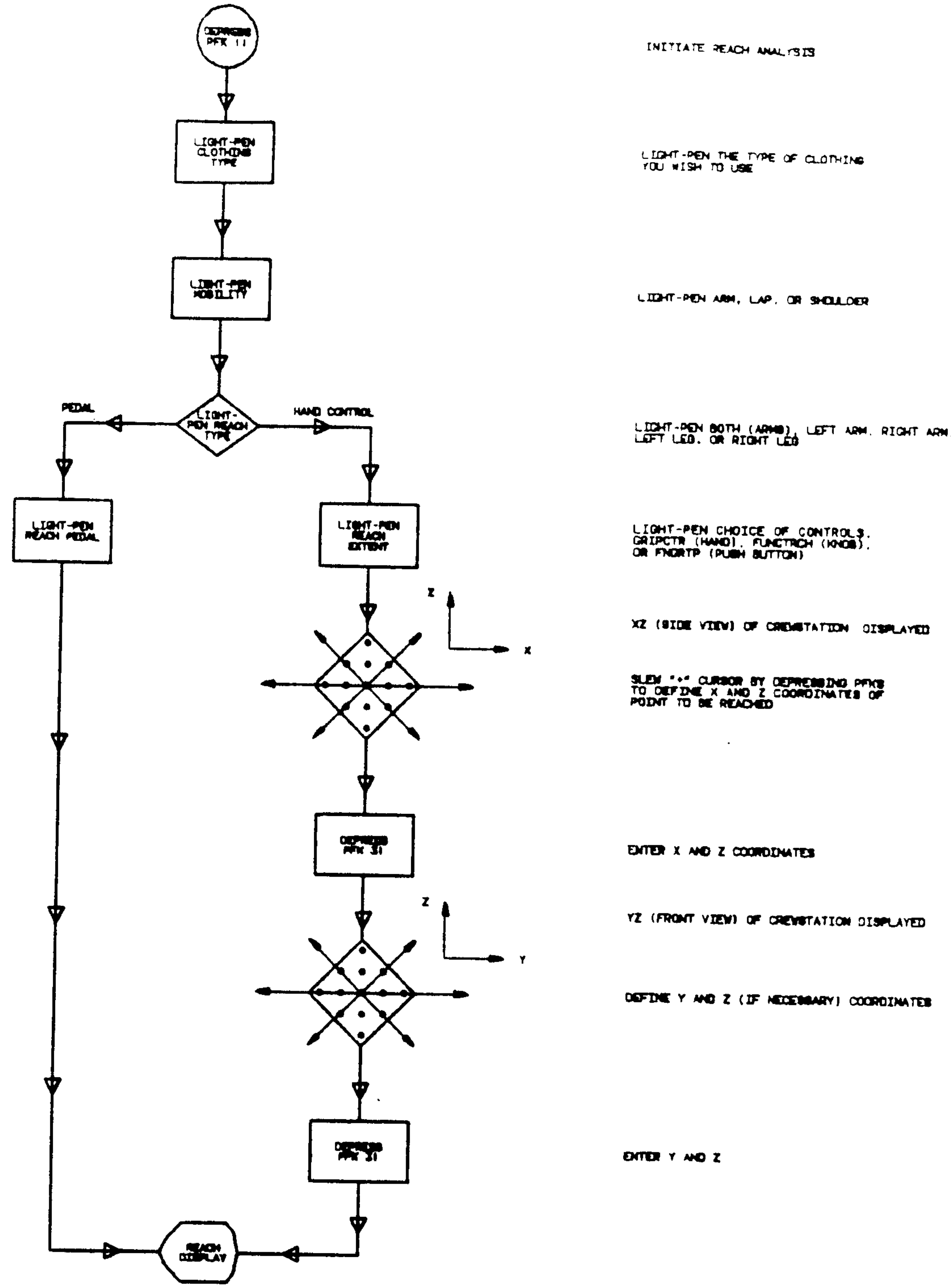



Figure 27. The Sequence of PERFORM REACH ANALYSIS.

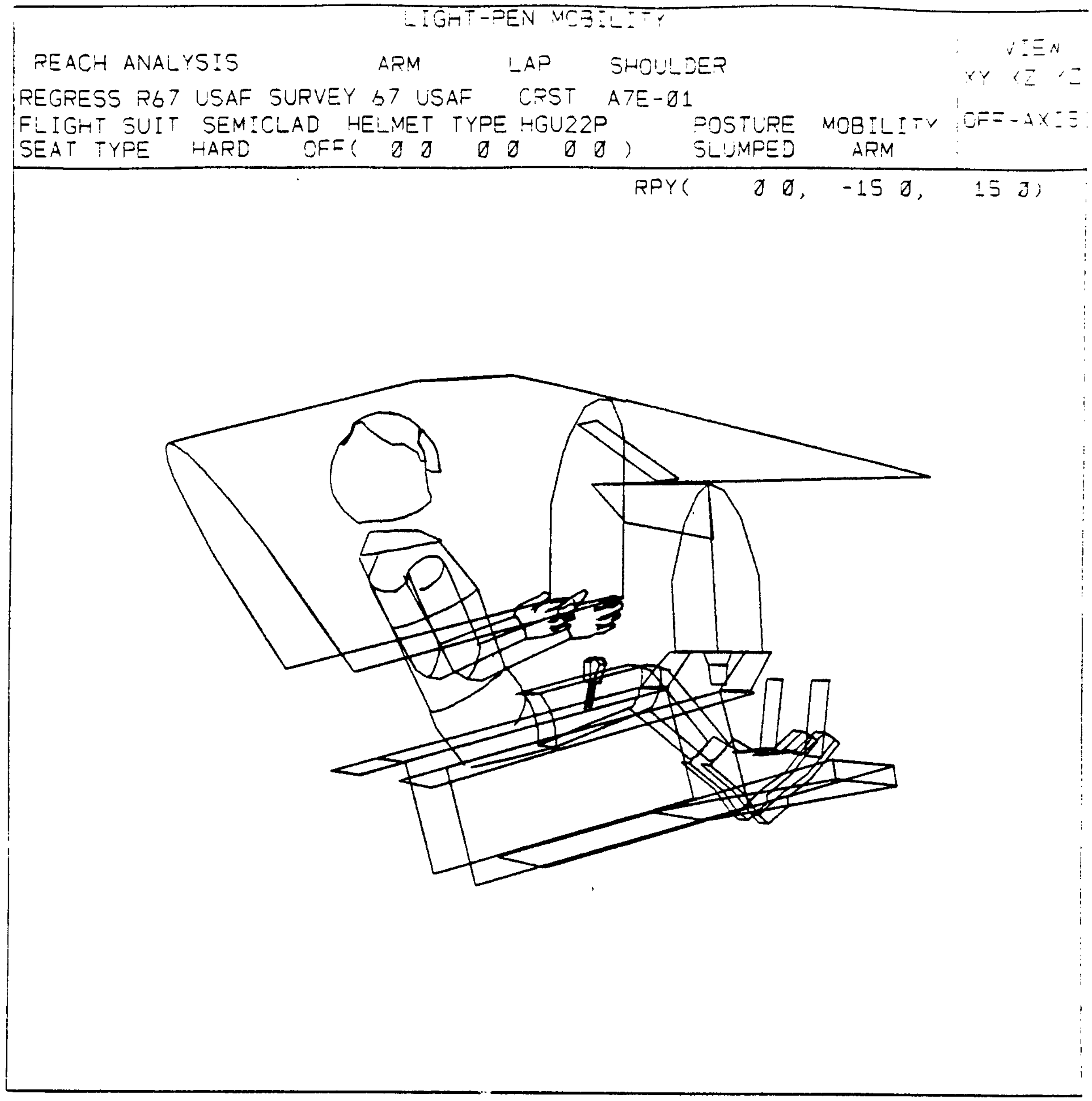



Figure 28. PERFORM REACH ANALYSIS Function Light Pen Reach Mobility.

SHOULDER selection - allows arm and shoulder movement with the torso fixed, as with a locked shoulder harness.

LAP selection - allows arm, shoulder and torso movement, as with a lap belt harness.

After the required reach mobility has been selected, the program prompts the user to light-pen the REACH TYPE, as shown in Figure 29. There are five choices:

| | |
|---|---|
| BOTH (both arms) | RLEG (right leg) |
| RARM (right arm) | LLEG (left leg) |
| LARM (left arm) | |

If an arm reach is selected, the program prompts the user to light-pen the EXTENT OF REACH, as shown in Figure 30. There are three choices:

GRIPCTR (grip center) - which indicates a grasping motion, such as grasping a control stick.

FUNCTRCH (functional) - which indicates a pinching motion, such as turning a knob.

FNGTP (finger tip) - which indicates a touching motion, such as pushing a button.

Figure 31 shows the three types of grips. The shape of the man-model hand remains the same regardless of the grip type selected. Once the "EXTENT OF REACH TYPE" has been selected, the program displays the man-model/crew station in the X-Z plane (side view) in a non-perspective view (see Paragraph 2.2.8).

The program prompts the user to position the cursor (+) at the point to be reached within the display area. The program uses a slewable "+" to locate the designate the 3-D coordinates of points of interest on the displayed image.

When either of the leg reach choices has been selected, a crew station is required. The program prompts the user to light-pen "PEDAL" to be reached. The slewable cursor is not used to identify the pedal to be reached.

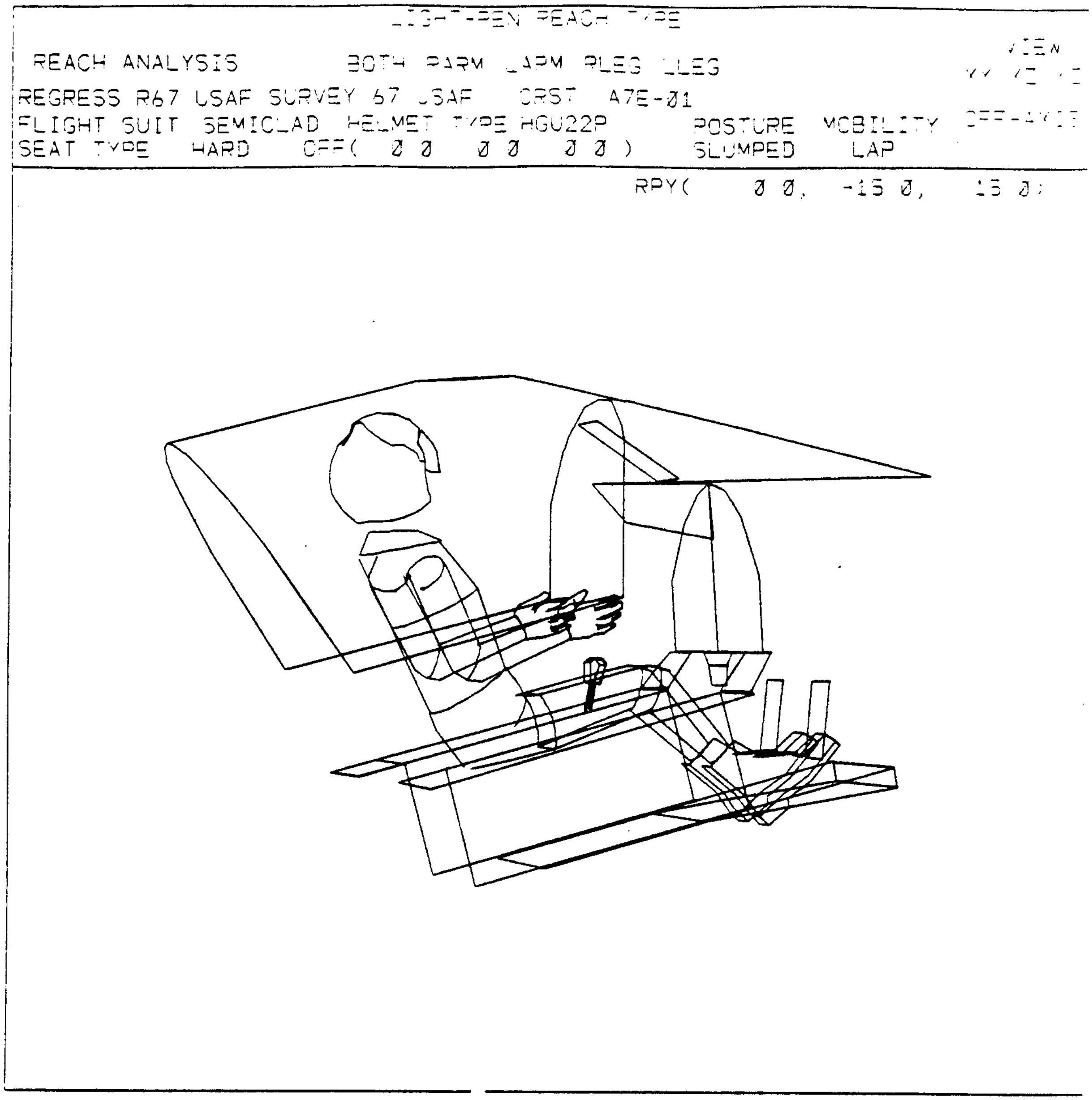



Figure 29. PERFORM REACH ANALYSIS Function Light Pen Reach Type.

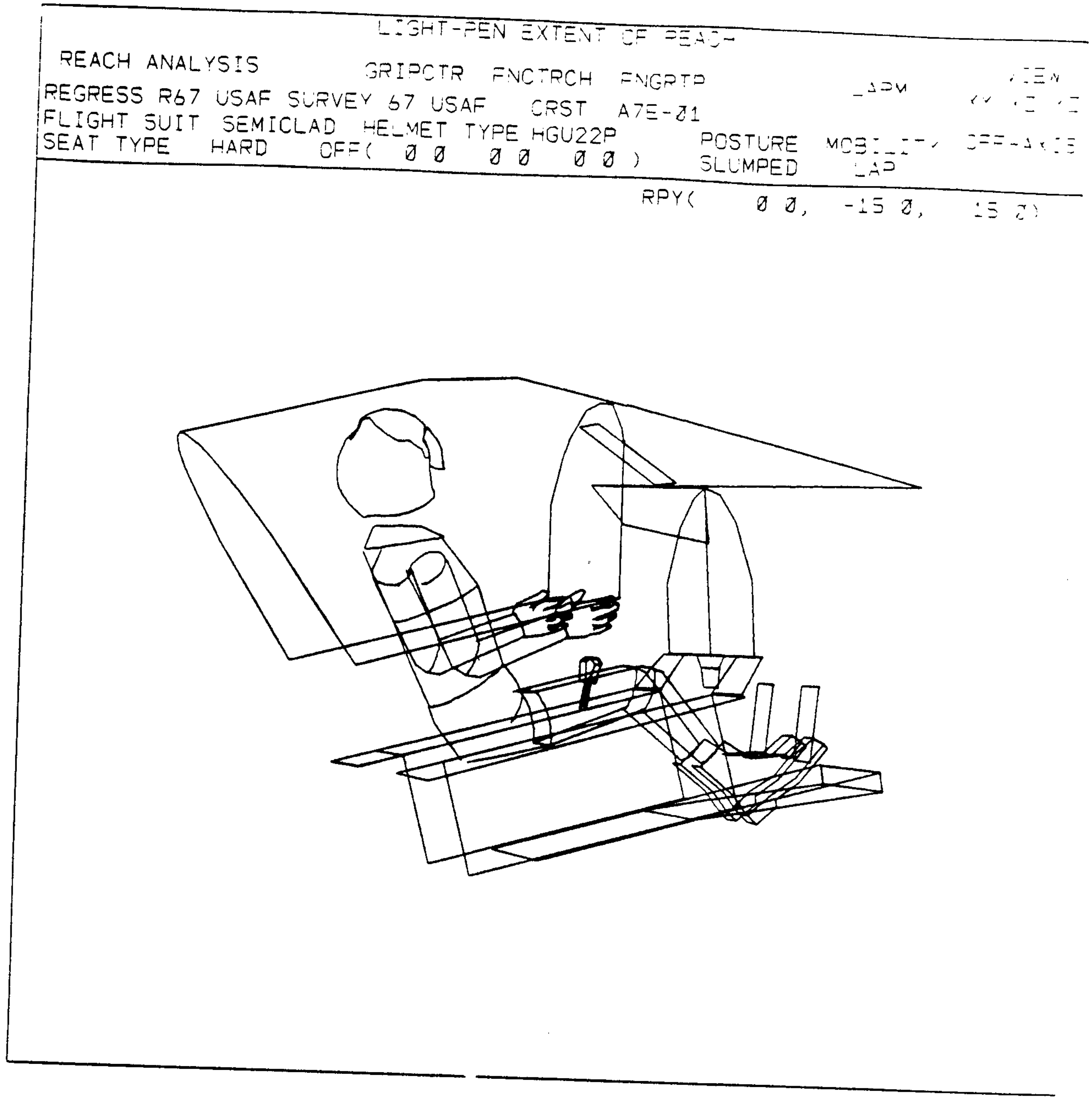
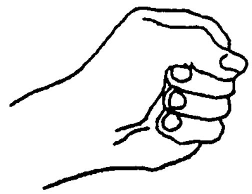
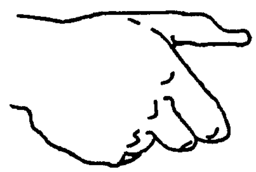


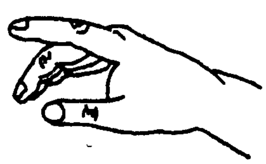

Figure 30. PERFORM REACH ANALYSIS Function Light Pen Extent of Reach.



GRIP CENTER



FUNCTIONAL REACH



FINGER TIP REACH

Figure 31. Relative Location of Grip Points.

### 2.2.11.1 Positioning the Cursor

Initially, the program displays a cursor ("+") symbol at the seat reference point (SRP). The user must first position the "+" in the X-Z plane (side view) to define the X and Z coordinates, and then in the Y-Z plane (front view) to define the Y-coordinate of the reach point. Note that the Z-coordinate can be redefined while positioning the cursor in the Y-Z plane. Figures 32 and 33 show the man-model in X-Z and Y-Z planes respectively with the "+" at a point to be reached on the instrument panel. The "+" is precisely positioned on a point using the Program Function Keyboard as described in the following paragraphs.

The PFK's are temporarily redefined as shown in Figure 34. The direction and magnitude of movement of "+" cursor on the screen when these PFKs are depressed are indicated inside the circles representing the PFKs in the figure. By selecting the proper PFK, the "+" cursor can be moved up, down, left, right, or combinations of these, at two different speeds. For example, depressing PFK7 causes the "+" to move up and right in one inch increments at a rate of approximately 10 steps per second.

Once in motion, the direction and/or magnitude of movement of the cursor can be changed simply by depressing another directional PFK. Cursor motion may be stopped by depressing the STEP key (PFK26) or the STOP key (PFK12). After depressing the STOP key (PFK12), motion can be resumed by selecting any direction key. As soon as the cursor is near the desired point, depress the STOP key (PFK12) or the STEP key (PFK26). The STEP key (PFK26) stops automatic motion of the cursor, allows the cursor to move in single steps of 0.1 or 1.0 inch each time a directional key is depressed. In this way, the cursor may be positioned precisely by (1) monitoring the position of the cursor relative to the displayed image, or (2) monitoring the X, Y, Z Coordinate Readout (see Figure 32) which appears in

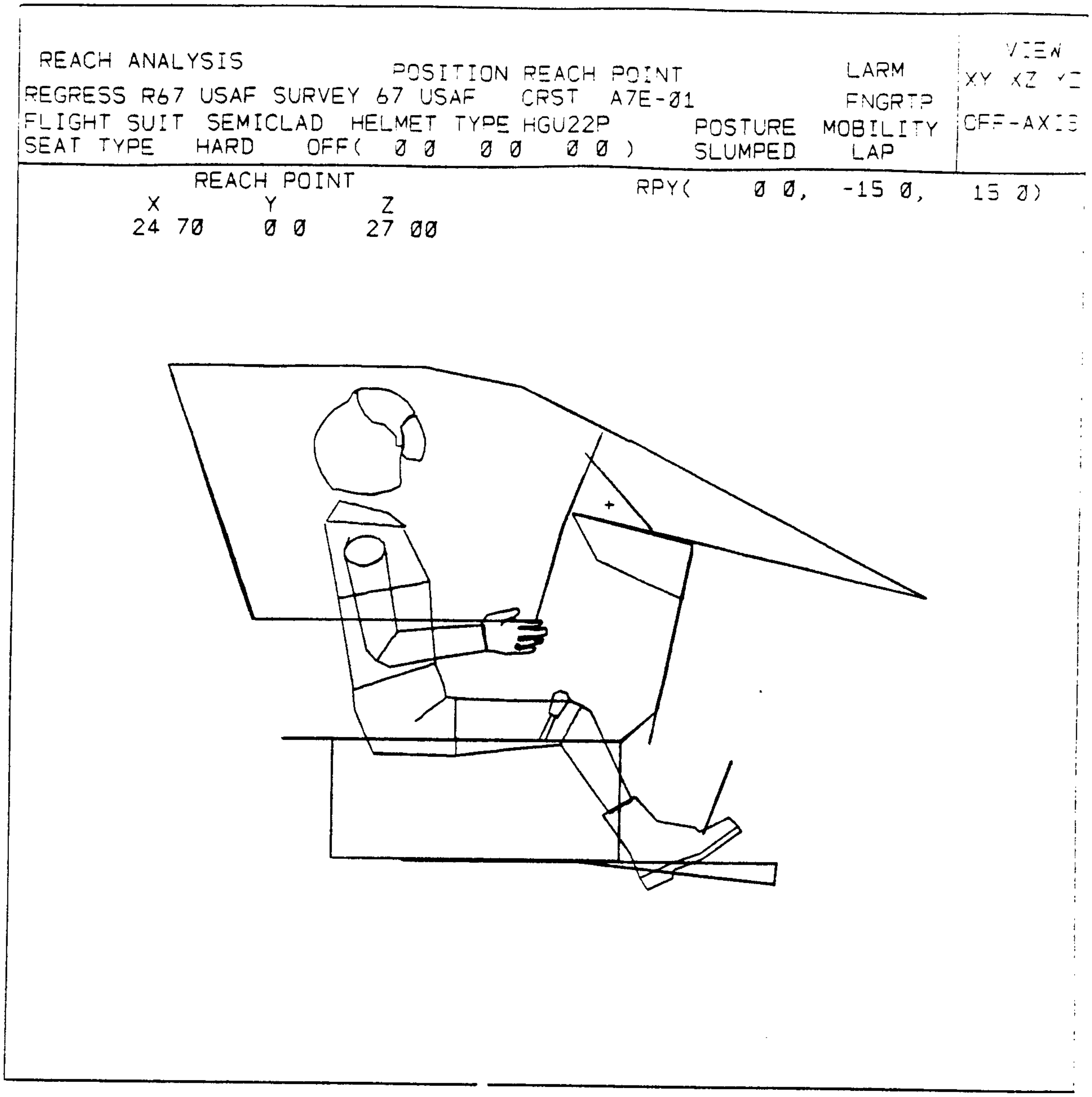



Figure 32. Side View (X-Z Plane) - the "+" Symbol Locates the Reach Point. The X and Z coordinates are defined in this view - note the coordinates displayed in the upper-left hand display area.

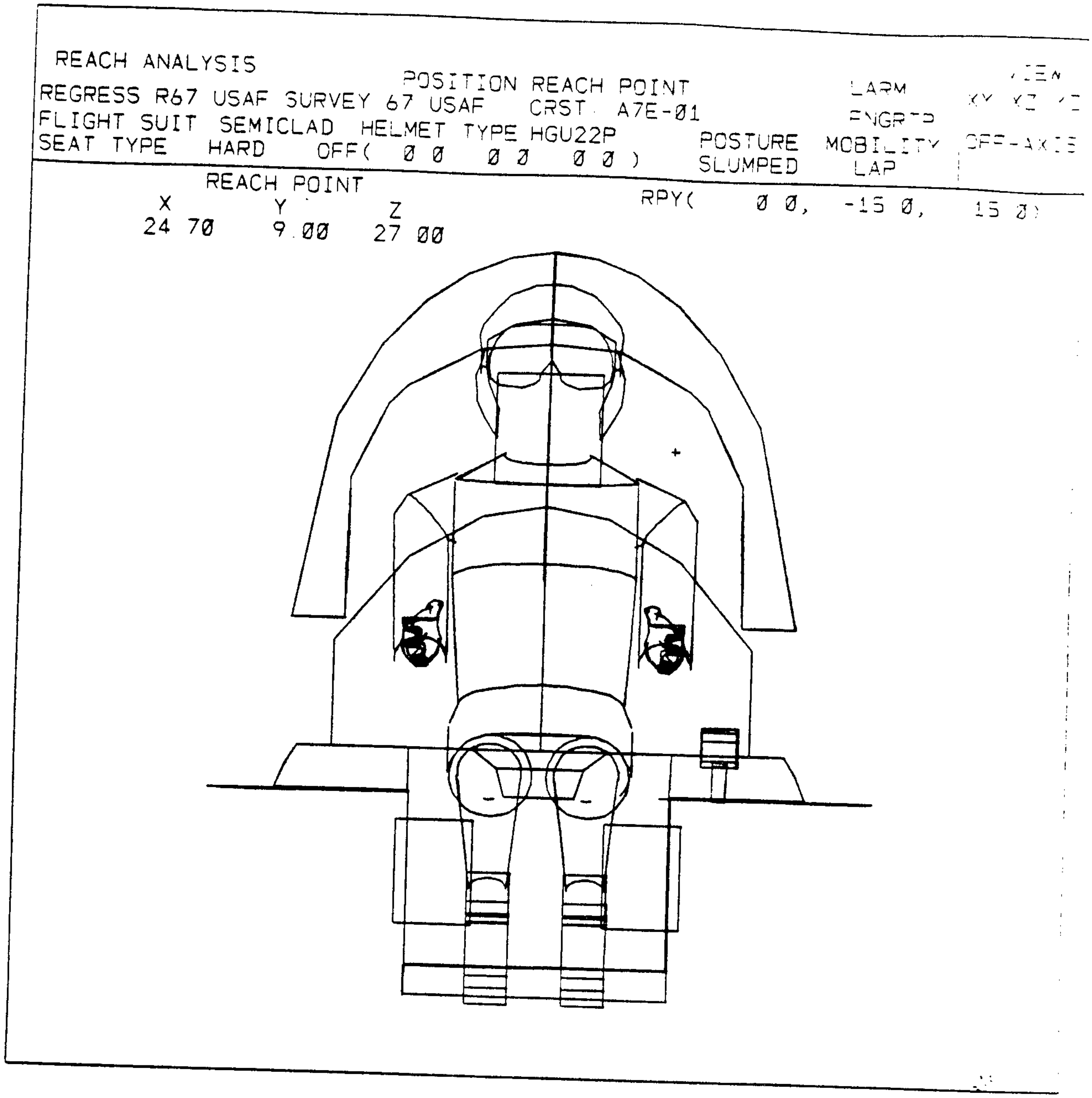



Figure 33. Front View (Y-Z Plane). The "cross" symbol is used to define the Y coordinate. The Z coordinate may also be redefined in this view.

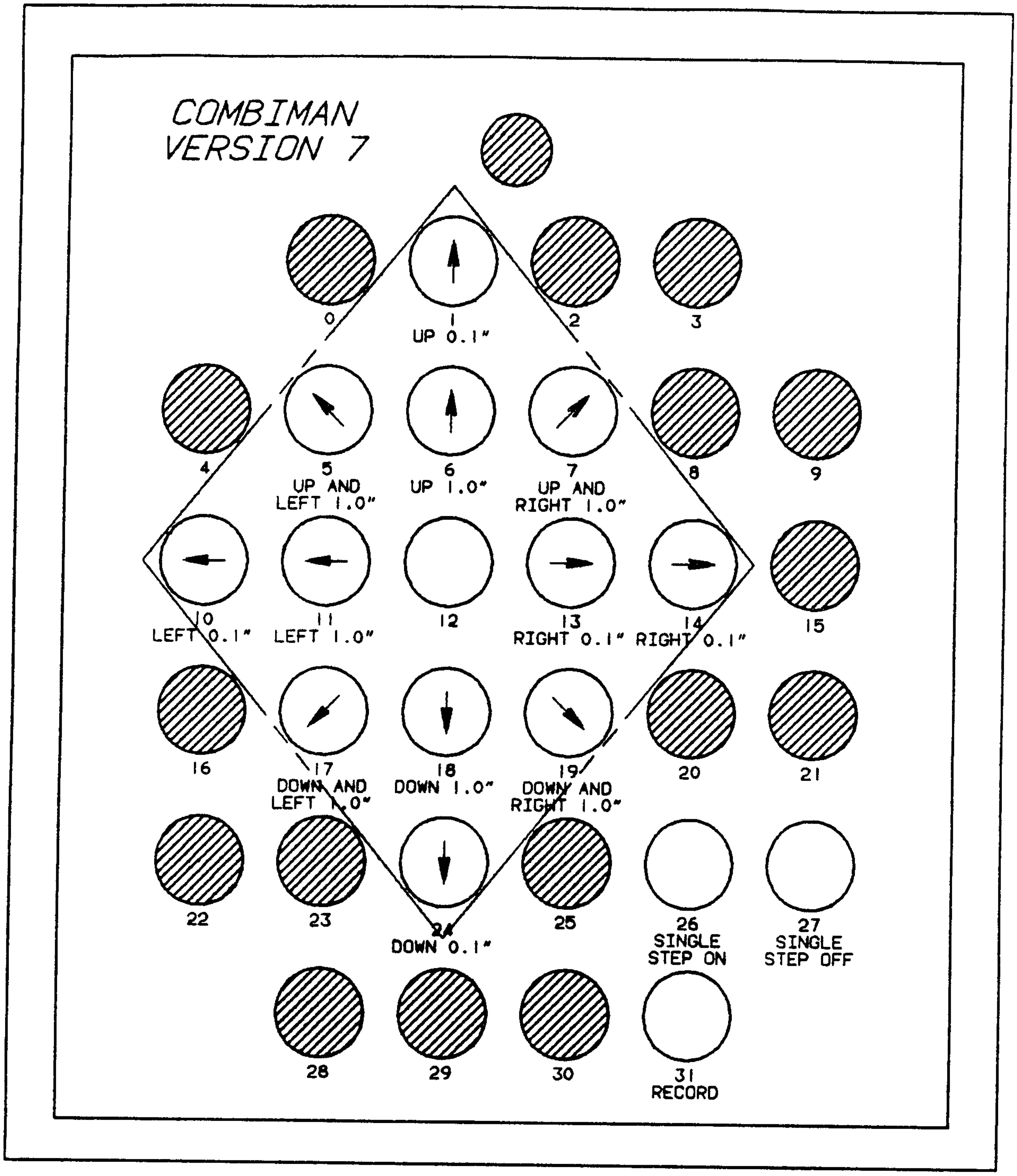



Figure 34. Redefined Program FUNCTION Keys for Positioning the "+" Symbol. Shaded keys are not used or illuminated.

the upper-left part of the Display Area when this function is in progress. This latter method is to be used when the coordinates of the point are known. Note that these coordinates are in the Neutral Seat Reference Point system.

To locate and enter a 3-D coordinate set proceed as follows:

- When the "+" is to be used to locate a point, the display automatically transitions to a side view (XZ plane).

- Move the cross to the desired location in the side view by the method described above.

- Depress the RECORD key (PFK31) to enter the X coordinate.

- The display automatically transitions to a front view (YZ plane).

- Use the left or right direction keys to position the cross in the Y-direction.

NOTE: If the cross is moved up or down, the Z coordinate is redefined.

- Depress the RECORD key (PFK31) to enter the Y and Z coordinates.

- The display automatically transitions to the orientation in use at the time the PERFORM REACH function was activated.

Now the PFKs are reset to their original definition and the man-model attempts to reach the specified point. When the reach is successful, "REACH SUCCESSFUL" is displayed in the Information Area of the display as shown in Figure 35. If the man-model could not reach the point, the message "MISS DISTANCE" and the miss distance value in inches are displayed in the Information Area of the CRT display as shown in Figure 36.

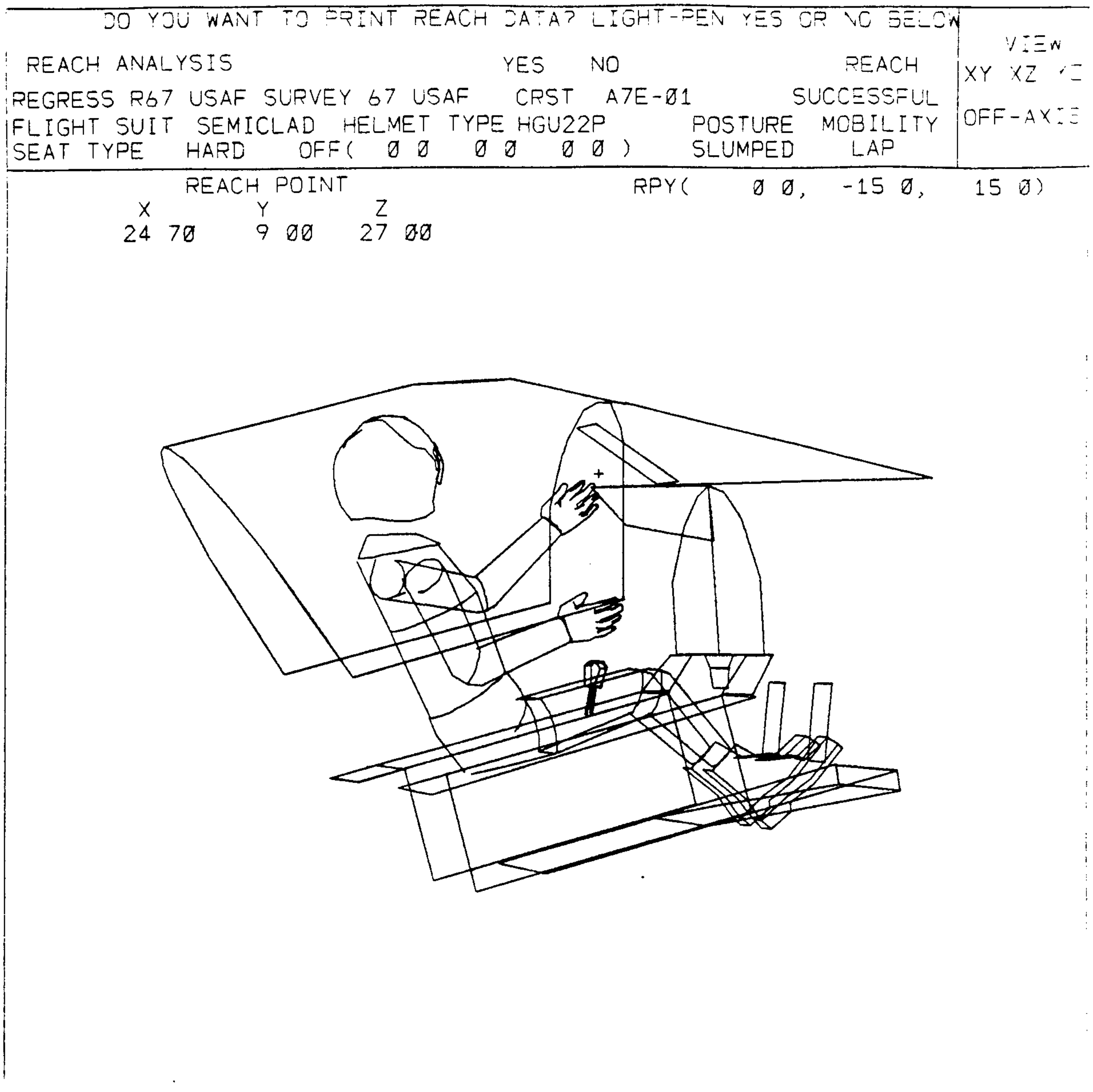



Figure 35. REACH SUCCESSFUL is Displayed after the Reach is Successfully Performed.

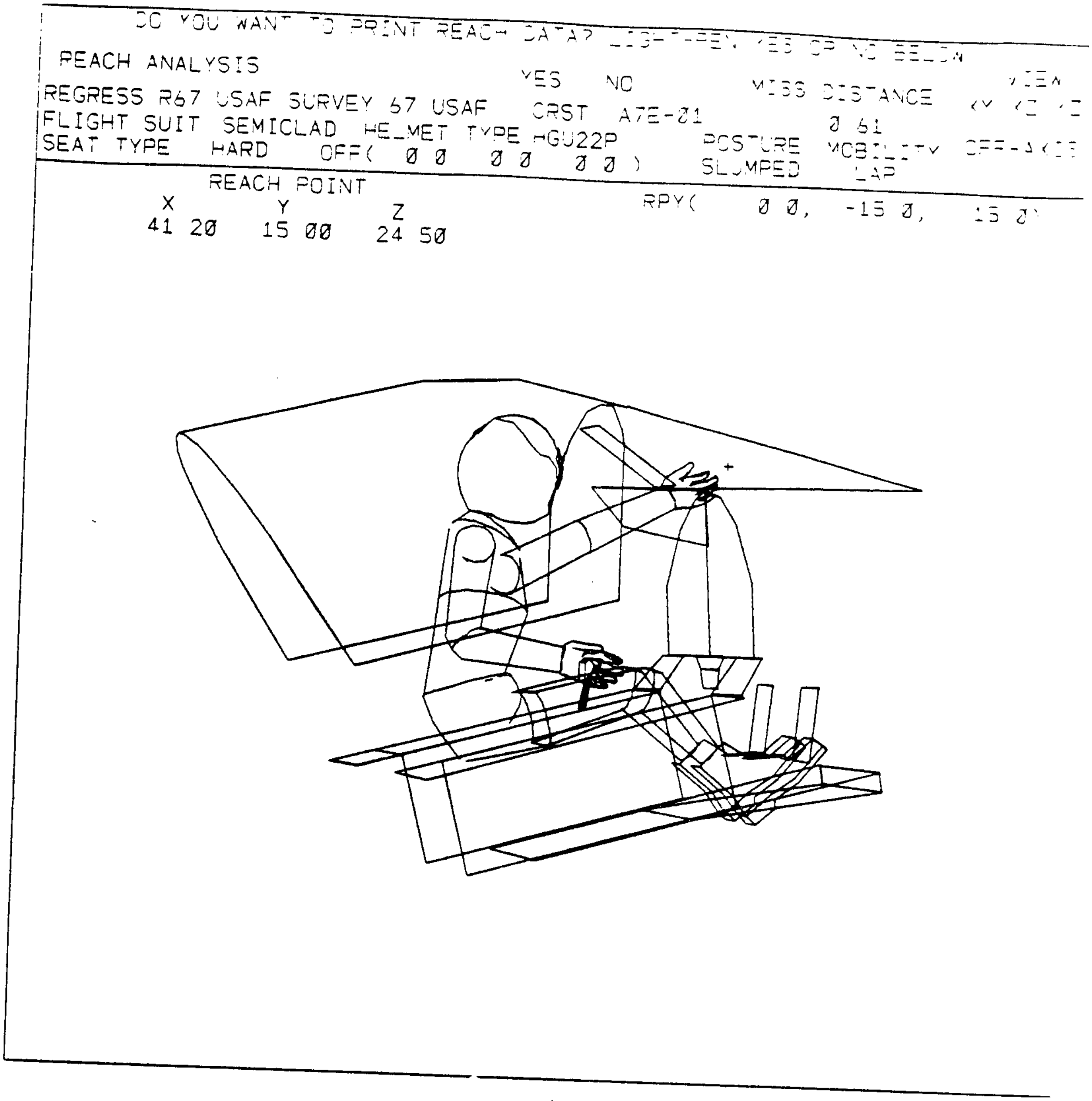



Figure 36. MISS DISTANCE is Displayed if the Man-Model Could Not Reach the Point.

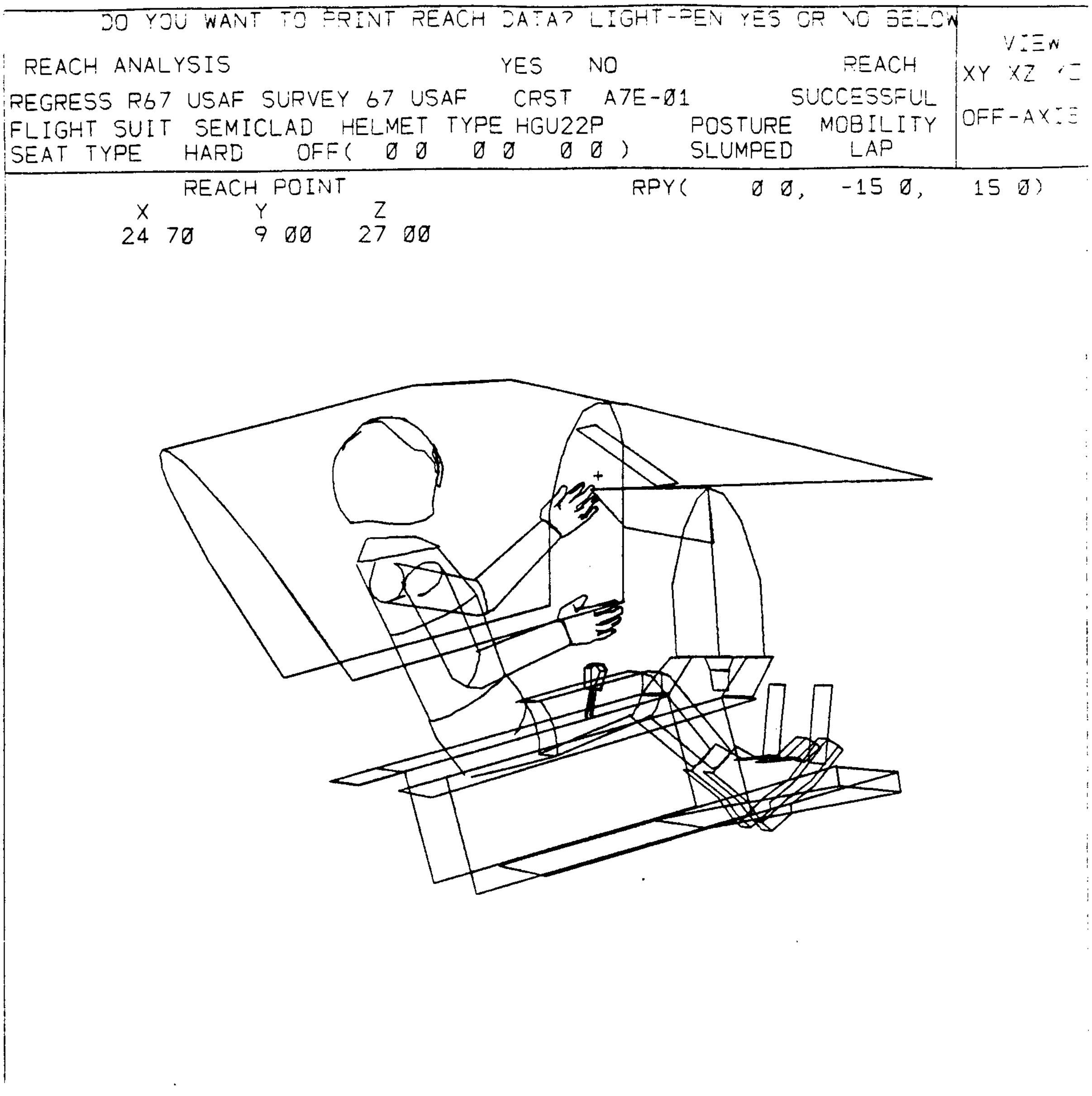



Figure 35. REACH SUCCESSFUL is Displayed after the Reach is Successfully Performed.

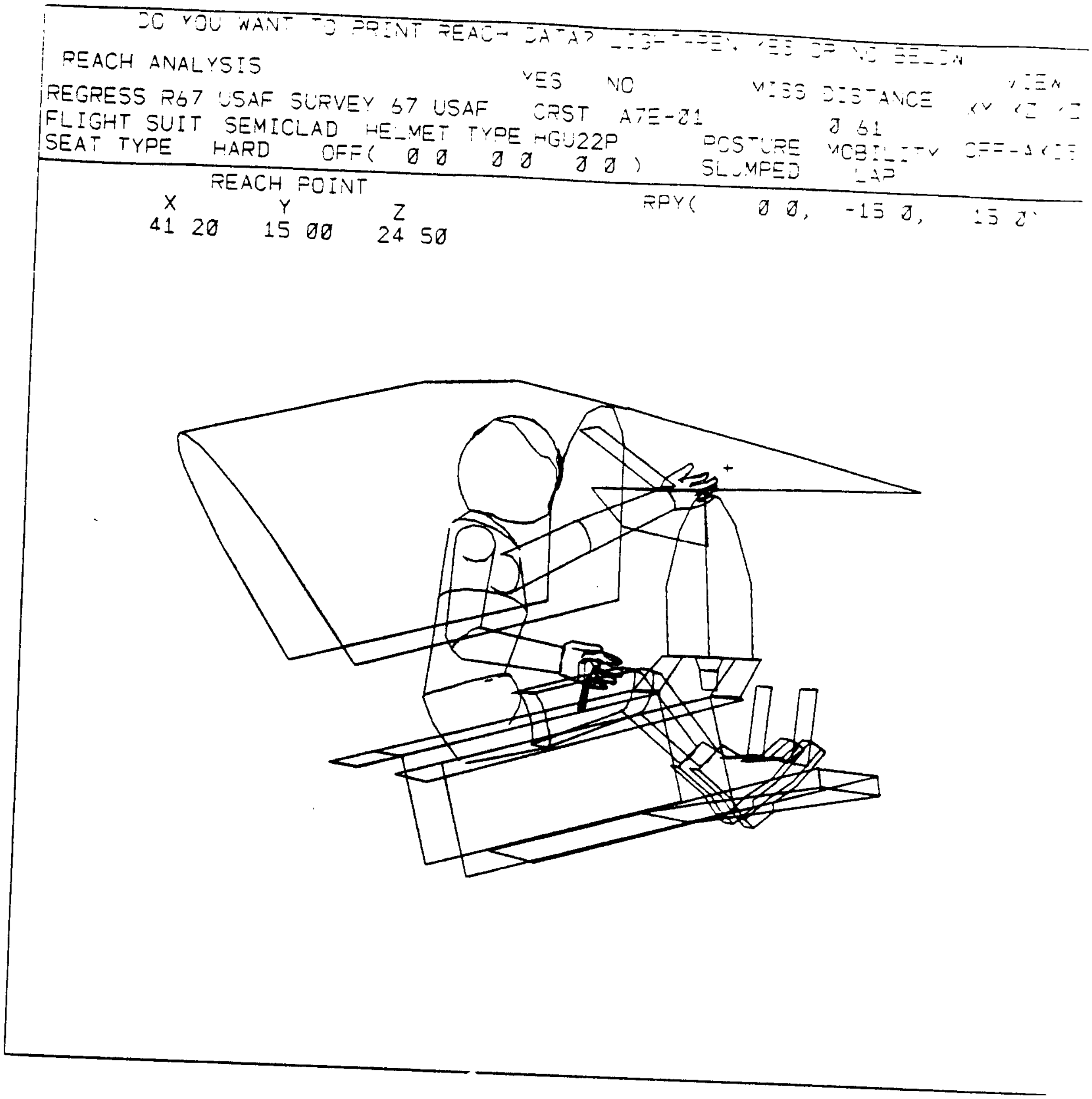



Figure 36. MISS DISTANCE is Displayed if the Man-Model Could Not Reach the Point.

2.2.11.2 Post Reach Processing

When the reach has been completed as indicated by "REACH SUCCESSFUL", see Figure 35, or "MISS DISTANCE", see Figure 36, appears on the CRT, the prompt message "DO YOU WANT TO PRINT REACH DATA? LIGHT-PEN YES OR NO" will appear.

YES selected - a summary of the reach analysis will be printed, see Figure 37.

NO selected - no print out will be made.

The sequence of the Post Reach Processing then continues, depending on the reach type previously selected (a reach by a single limb (arm or leg), and a reach by both arms).

When a single limb reach has been previously selected the prompt message "DO YOU WANT TO RESET POSTURE? LIGHT-PEN YES OR NO BELOW" appears. See Figure 38.

NO selected - reach analysis ends and the prompt message "PRESS PFK TO SELECT A FUNCTION" appears.

YES selected - posture resets to the original (slumped) posture.

The prompt message "DO YOU WANT TO CONTINUE REACH? LIGHT-PEN YES OR NO BELOW" APPEARS.

NO selected - the prompt message "PRESS PFK TO SELECT FUNCTION" appears.

YES selected - the reach analysis continues with the same mobility as previously selected. The prompt message "LIGHT-PEN REACH TYPE" appears. (Reference Paragraph 2.2.11).

When a two arm reach has been previously selected the prompt message "DO YOU WANT TO RESET POSTURE? LIGHT-PEN YES OR NO" appears. See Figure 38.

NOTE: In a two arm reach the right arm is moved first. The NO selection may have two responses. One for a "SUCCESSFUL REACH" and the other for a "MISS".

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COMBIMAN REACH ANALYSIS

| RCH NO. | RCH TYPE | RCH PT. | DIST. TO RCH PT. | POSTURE | MOBILITY |
|---|---|---|---|---|---|
| 2 | 1 LEFT ARM | ( 27.00, 9.00, 27.00) | 0.00 | SLUMPED | LAP |

COMBIMAN RUN SUCCESSFUL

Figure 37. PERFORM REACH Function Printout Obtained When User Responds "YES" to Message "PRINT REACH DATA? L.P. YES or NO".

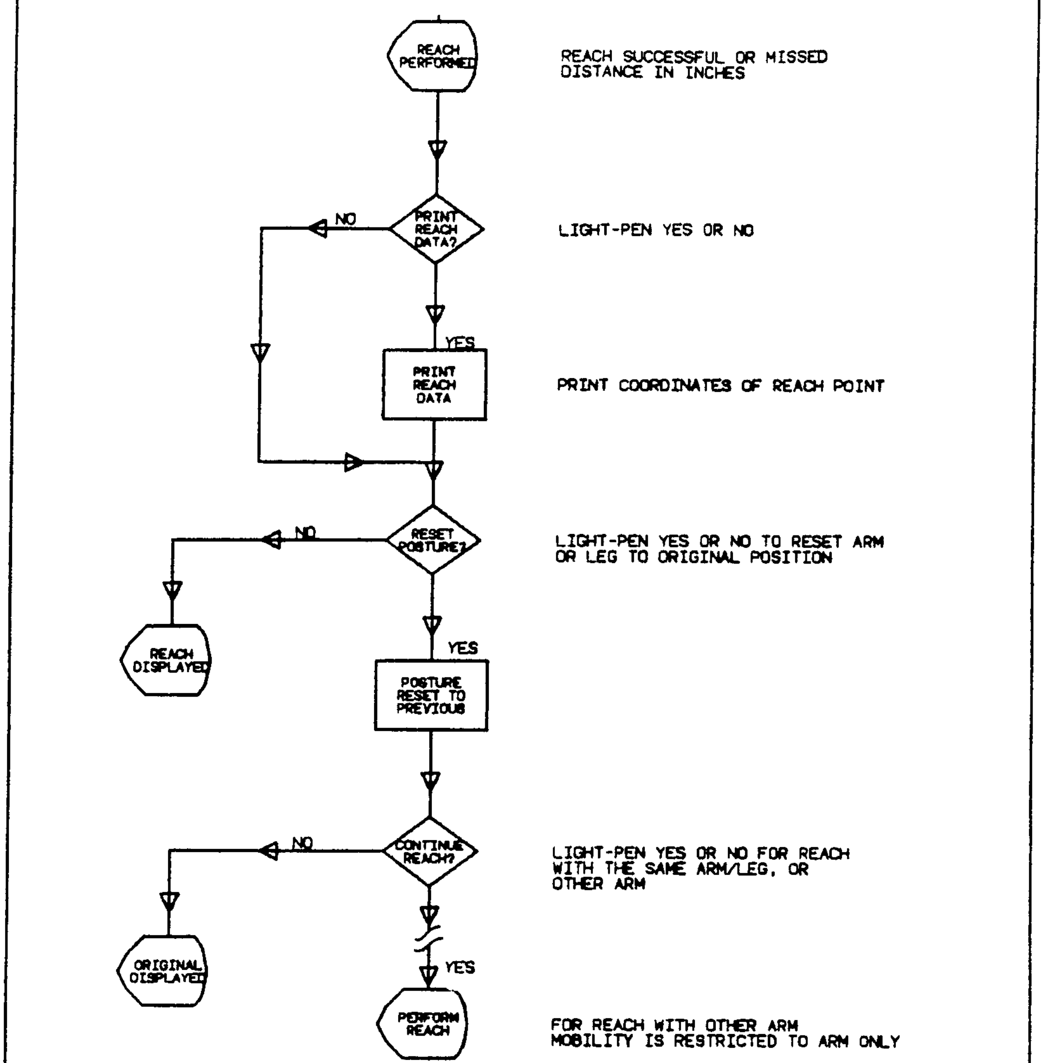



Figure 38. Sequence of Post-Reach Procedure.

NO selection (right arm reach SUCCESSFUL)-Posture saved and reach function continued with a left arm reach. The prompt message "LIGHT-PEN EXTENT OF REACH" appears.

NO selection (right arm reach MISS)-Reach function will end. The prompt message "PRESS PFK TO SELECT FUNCTION" appears.

YES selection-posture resets to posture selected before reach was performed. The prompt message "DO YOU WANT TO CONTINUE REACH? LIGHT-PEN YES OR NO BELOW" appears.

NO selection-reach analysis ends, the prompt message "PRESS PFK TO SELECT FUNCTION" appears.

YES selection-the prompt message "LIGHT-PEN REACH TYPE" appears.

After the left hand reach portion to the two arm function (BOTH) has been completed the prompt message "DO YOU WANT TO RESET POSTURE? LIGHT-PEN YES OR NOW BELOW" appears.

NO selection-reach analysis ends. The prompt message "PRESS PFK TO SELECT FUNCTION" appears.

YES selection-resets posture to posture selected before left arm portion of the reach was performed. The prompt message "LIGHT-PEN EXTENT OF REACH" appears.

### 2.2.12 INPUT 12 ANTHROPOMETRIC DIMENSIONS Function (PFK12)

This is one of two procedures to define the body size of the man-model. The other method is described in Paragraph 2.2.13. The INPUT 12 ANTHROPOMETRIC DIMENSIONS function allows the user to supply values, either as percentiles or as absolute dimensions, for each of the dependent anthropometric variables necessary to construct the link system of the man-model. This function can be selected by depressing PFK12.

There are basically three methods for entering anthropometry using this function: (1) reading anthropometry data from cards, (2) entering values from the keyboard, or, (3) by selecting a percentile value from the menu on display. The sequence for selecting the variables using methods (2) and (3) are shown in Figure 39.

Method 1) - Reading anthropometry data from cards. If State Switch 22 is previously set "ON", the message "DO YOU WANT TO READ ANTH DATA FROM CARD? ENTER Y/N" is displayed in the Prompting Area of the CRT. If the answer is "YES" or "Y" through the ANKB, the 12 dependent anthropometric dimensions, in the default units of measure, are read from input cards in the format shown in Figure 40. The function then returns control to the main routine to generate the man-model. If the response is "NO" or "N", or the ALT-CODE/5 sequence, or if State Switch 22 is not set "ON" the program bypasses the card input option.

- When the card input option is bypassed the message "DO YOU WANT VALUES FOR PERCENTILES? ENTER Y/N is displayed. The users' response leads to Method 2 or 3. A "NO" or "N" response leads to Method 2. A "YES" or "Y" response leads to Method 3. The procedures for each method follows.

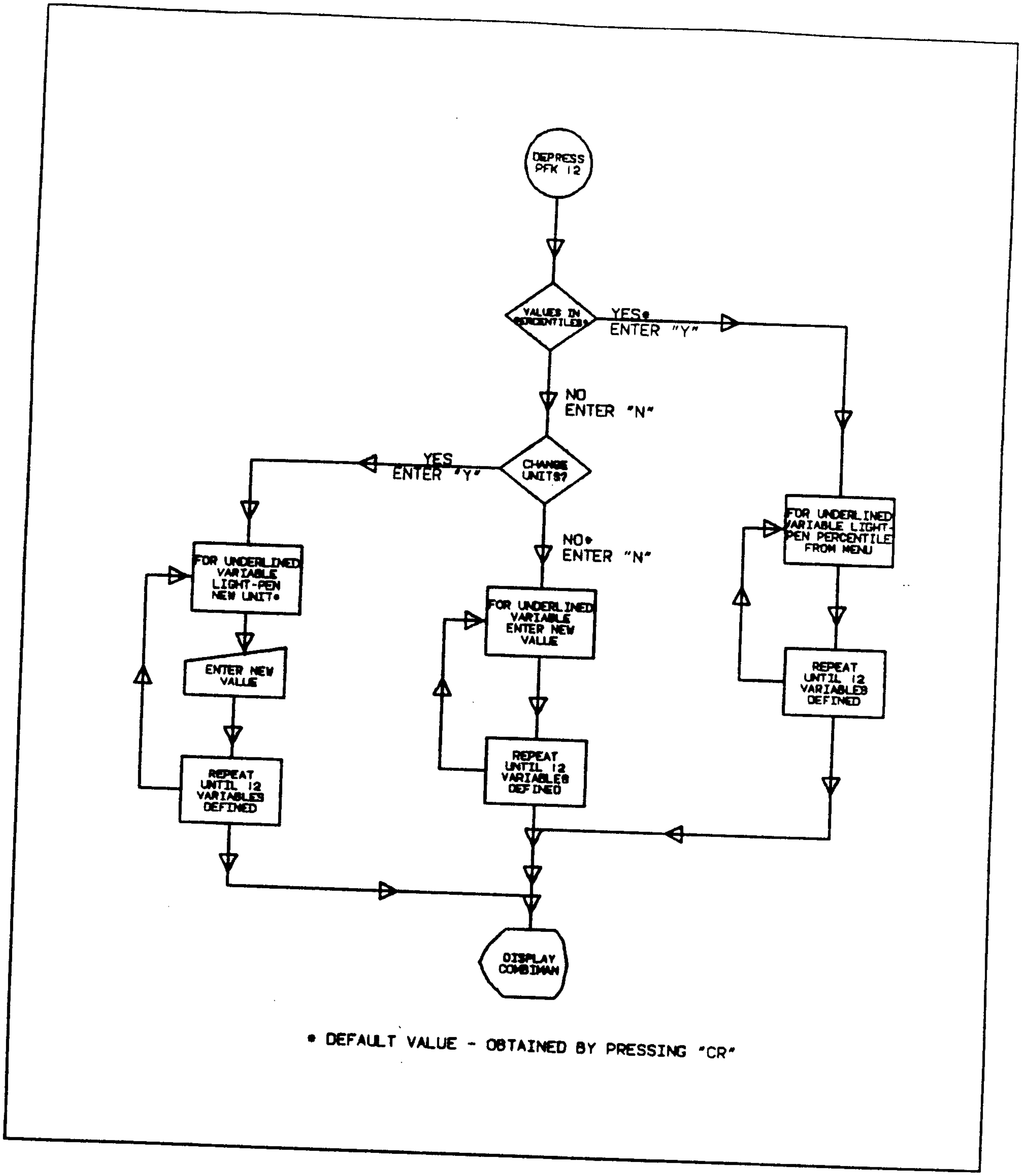



Figure 39. Sequence for Selecting 12 Anthropometric Variables to Define or Redefine Body Size of COMBIMAN.

```
**** TSO FOREGROUND HARDCOPY ****
DSNAME=COMBIMAN.SMPLANTH

128.034.5722.8420.7523.0314.2115.9112.409.02 10.087.44 11.56
140.035.8323.3923.0724.6516.1815.9513.988.82 11.307.84 12.63
147.034.2921.6920.4722.6 12.4415.2013.509.61 9.92 7.13 10.90
152.035.6324.1320.8723.2314.4515.4713.159.80 10.837.36 11.50
159.035.7924.2121.6124.0614.6115.5113.749.33 10.167.40 11.99
164.037.0924.6521.6523.5813.8616.3413.359.76 10.397.52 11.58
172.038.1525.2022.1724.7613.9016.8113.789.41 10.557.36 11.58
181.038.2724.9222.8324.6514.4917.4413.7410.9110.517.68 12.01
187.037.3623.7023.1925.8314.8816.3014.379.57 11.308.19 12.87
196.037.0524.4122.5625.5914.5317.0915.0 10.5910.877.99 12.19
202.036.0223.4724.6426.7715.0416.5415.5510.7111.508.23 12.64
211.036.1424.0622.0924.8814.7617.1314.8011.6511.187.72 11.97
221.039.0226.0222.6025.3515.2016.6514.7210.4310.717.76 11.77
228.039.3325.7922.9925.0 14.3716.4215.3911.0611.307.76 12.99
145.033.9421.3420.3522.7612.9915.8312.959.02 9.65 6.93 10.39
149.034.2521.4621.1023.2713.7015.5913.0310.5110.127.24 11.34
163.034.6922.3621.6123.7413.7816.3013.709.88 9.21 7.01 11.30
164.035.1223.1920.3222.3613.9016.0613.9810.1210.477.28 10.91
150.035.3922.8019.6521.2613.2715.9113.079.57 10.287.09 10.71
140.035.8323.3923.0724.6516.1815.9513.988.82 11.307.84 12.64
175.036.1824.6520.7123.4314.6916.0614.3310.1210.0 7.32 11.65
179.036.6524.2921.3423.9013.9815.9514.6110.6710.477.13 11.77
171.037.1723.1522.1323.3514.2116.7714.6510.1210.957.68 11.44
173.037.5224.0622.8724.2914.7617.8014.029.84 10.718.07 12.24
188.037.9925.3223.2324.8015.0 16.3014.4110.2810.957.60 12.60
177.038.3524.6922.7625.5915.4315.8713.908.98 11.187.95 11.81
192.038.8225.3922.8724.9215.2017.3214.659.88 11.147.64 11.93
160.039.2926.1422.6823.1114.5316.8912.878.39 11.027.87 11.93
184.039.6125.2023.2324.6514.8416.3813.709.21 11.267.64 12.07
133.035.1222.5621.3822.6 13.7814.5313.278.03 10.327.56 11.46
```

Figure 40. DATA SET - COMBIMAN.SMPLANTH (Card Image). Each card contains 12 Independent Anthropometric Variable in F5.2 format to create a man-model.

Method 2) - Entering Values from the Keyboard.

There are are two options available for entering values from the keyboard; 2A (Change units of measure, if other than inches and pounds) and 2B (Enter values in inches and pounds). The option is dictated by the users' response to the message "DO YOU WANT TO CHANGE UNIT? (of measurement) ENTER Y/N".

2A. "YES" or "Y" response, followed by "CR". (Left hand path in Figure 39.)

First variable name is underlined and the message "LIGHT-PEN NEW UNIT OR DEPRESS CR" is displayed as shown in Figure 41. The user may light pen a new unit from the menu of available units (in, cm, mm, lb or kg), or depress "CR" key to retain the default unit for that variable. The message "ENTER NEW VALUE" appears in the Prompting Area of the CRT as shown in Figure 42.

2B. "NO" or "N" response, followed by "CR". (Center path in Figure 39).

First variable name is underlined and the message "ENTER NEW VALUE" appears in the Prompting Area of th CRT (see Figure 42).

- The user types in the numeric quantity, followed by "CR". The process then repeats as each of the 12 dependent variables is underlined. Control then returns to the main routine for man-model generation.

NOTE: Since the unit of measurement is declared for each number entered, the numbers do not need to be in the same units. Inches, centimeters and millimeters may be mixed as desired, as may pounds and kilograms. Though the values may be mixed, they are converted to pounds and inches for processing, display and printouts.

LIGHT-PEN NEW UNIT OR DEPRESS CR

SURVEY MEMBER R67 USAF

| INDEPENDENT VARIABLES MASS RELATED | UNIT | INPUT | AVBL UNITS | AVBL PCTL |
|---|---|---|---|---|
| WEIGHT | LB | | IN | 1<br>2 |
| SITTING HEIGHT | IN | | CM | 3<br>5 |
| ACROMION HGT/SIT | IN | | MM | 10<br>15 |
| SHOULDER-ELB LGTH | IN | | LB | 20<br>25 |
| KNEE HGT/SITTING | | | KG | 30<br>35 |
| BUTTOCK-KNE LGTH | | | | 40<br>45 |
| BIACROMIAL BRDTH | | | | 50<br>55 |
| HIP BREADTH | | | | 60<br>65 |
| CHEST DEPTH | | | | 70<br>75 |
| FOOT LENGTH | | | | 80<br>85 |
| HAND LENGTH | | | | 90<br>95 |
| ELBOW-WRIST LGTH | | | | 97<br>98 |
| | | | | 99 |

Figure 41. INPUT 12 ANTHROPOMETRIC DIMENSIONS Function Choose New Unit for Input Value.

ENTER NEW VALUE
72.5_
SURVEY MEMBER R67 USAF

INDEPENDENT VARIABLES

| MASS RELATED | UNIT | INPUT |
|---|---|---|
| WEIGHT | KG | |
| SITTING HEIGHT | IN | |
| ACROMION HGT/SIT | IN | |
| SHOULDER-ELB LGTH | IN | |
| KNEE HGT/SITTING | | |
| BUTTOCK-KNE LGTH | | |
| BIACROMIAL BRDTH | | |
| HIP BREADTH | | |
| CHEST DEPTH | | |
| FOOT LENGTH | | |
| HAND LENGTH | | |
| ELBOW-WRIST LGTH | | |

AVBL UNITS
IN
CM
MM
LB
KG

AVBL PCTL
1
2
3
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
97
98
99

Figure 42. INPUT 12 ANTHROPOMETRIC DIMENSIONS Function Sample Input in Engineering Unit.

Method 3) - Selecting a percentile value if the user responds "YES" or "Y" or simply depresses the CR key to the prompting message "DO YOU WANT VALUE IN PERCENTILES? ENTER Y/N", values are selected for each of the 12 dependent variables as percentile of the survey chosen as illustrated in the right-hand path of Figure 39 as follows:

- The first variable name is underlined and the user receives the prompt "LIGHT-PEN PERCENTILE".
- The user then light-pens the desired percentile from the menu of available percentiles on the right side of the Display Area. The above procedure is repeated for each of the 12 dependent variables. Figure 43 shows the Display after defining the first three variables. Control then returns to the main program for man-model generation.

After all of the necessary anthropometric sizes have been input, the user is prompted to "SELECT CLOTHING TYPE" from the menu shown in Figure 44. There are 6 different clothing types available, plus a semiclad baseline condition. The different clothing types are: summer suit; summer suit with vest; winter suit; winter suit with vest; winter suit with vest, jacket, and life preserver; and chemical defense ensemble. The user need merely light-pen the type at clothing he wants to use.

LIGHT-PEN PERCENTILE

SURVEY MEMBER R67 USAF

INDEPENDENT VARIABLES

| MASS RELATED | UNIT | INPUT |
|---|---|---|
| WEIGHT | LB | 30 PCT |
| SITTING HEIGHT | IN | 65 PCT |
| ACROMION HGT/SIT | IN | 45 PCT |
| SHOULDER-ELB LGTH | IN | |
| KNEE HGT/SITTING | | |
| BUTTOCK-KNE LGTH | | |
| BIACROMIAL BRDTH | | |
| HIP BREADTH | | |
| CHEST DEPTH | | |
| FOOT LENGTH | | |
| HAND LENGTH | | |
| ELBOW-WRIST LGTH | | |

AVBL UNITS

IN
CM
MM
LB
KG

AVBL PCTL

1
2
3
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
97
98
99

Figure 43. Light Pen Percentile Values for the INPUT 12 ANTHROPOMETRIC DIMENSIONS Function.

LIGHT- PEN CLOTHING TYPE

SEMICLAD

SUMMER SUIT

SUMMER SUIT W/VEST

WINTER SUIT

WINTER SUIT W/VEST

WINTER SUIT W/VEST  JACKET AND LIFE PRESERVER

CHEMICAL DEFENSE

Figure 44.  Select Clothing Type.

### 2.2.13 INPUT TWO INDEPENDENT VARIABLES Function (PFK13)

This is the most frequently used method of defining COMBIMAN'S body size. The "two variable" method provides a body size and proportion which is most representative of the population, whereas the 12 variable method (PFK12) is most useful for representing an individual. The two variable method allows the user to select the variable which is most relevant to the evaluation task being performed (one length variable to define the skeletal system of the COMBIMAN and one mass variable to define the amount of enfleshment on COMBIMAN's skeleton) and regression equations based on large samples are used to define the other needed variables. This method gives the user the most probable body proportions for a selected size of the chosen variables (see Figure 45).

Which variable the user selects depends on the evaluation being performed. For example, if the user is evaluating head clearance in the crewstation, then Sitting Height is the most relevant variable. If the user is evaluating vision requirements, then Eye Height, Sitting is the most relevant variable. If evaluating operability of hand controls, then Arm Length is the most relevant variable. When evaluating the operability of foot pedals, then Leg Length is the most relevant variable.

Normally, the length dimension is defined first and weight is selected for the mass variable. When this is done, the program cues the user as to the reasonable range of body weights for the length value selected. Values supplied by the user can be either in percentiles of the selected anthropometric survey member, or in engineering units.

After depressing PFK13, the CRT is formatted as shown in Figure 46. The left and center portions of the screen contain the columns of mass and length related variables, respectively. To the right of each variable name is the default or predefined unit of measurement. The right portion of the

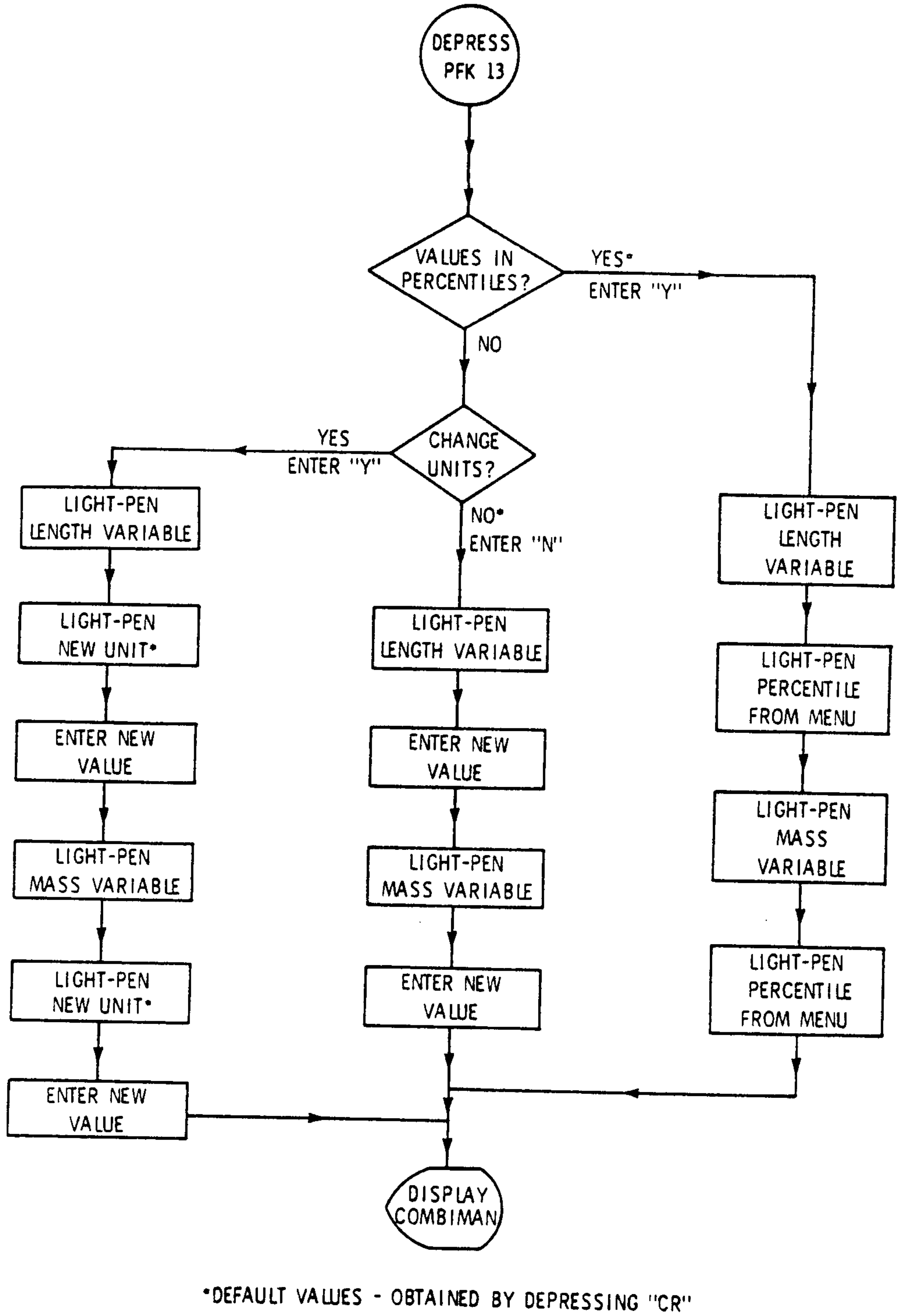



Figure 45. The Sequence to Select Two Anthropometric Variables to Define or Redefine the Body Size of COMBIMAN.

DO YOU WANT VALUES IN PERCENTILES? ENTER Y/N

SURVEY MEMBER R&7 USAF

INDEPENDENT VARIABLES

| MASS RELATED | UNIT | INPUT | LENGTH RELATED | UNIT | INPUT | AVBL UNITS | AVBL PCTL |
|---|---|---|---|---|---|---|---|
| WEIGHT | LB | | SITTING HEIGHT | IN | | IN | 1 |
| | | | | | | | 2 |
| BIDELTOID BRDTH | IN | | EYE HGT/SITTING | IN | | CM | 3 |
| | | | | | | | 5 |
| HIP BREADTH/SITT | IN | | ARM LENGTH | IN | | MM | 10 |
| | | | | | | | 15 |
| CHEST DEPTH | IN | | THUMB-TIP REACH | IN | | LB | 20 |
| | | | | | | | 25 |
| | | | KNEE HGT/SITTING | IN | | KG | 30 |
| | | | | | | | 35 |
| | | | BUTTOCK-KNE LGTH | IN | | | 40 |
| | | | | | | | 45 |
| | | | LEG LENGTH | IN | | | 50 |
| | | | | | | | 55 |
| | | | | | | | 60 |
| | | | | | | | 65 |
| | | | | | | | 70 |
| | | | | | | | 75 |
| | | | | | | | 80 |
| | | | | | | | 85 |
| | | | | | | | 90 |
| | | | | | | | 95 |
| | | | | | | | 97 |
| | | | | | | | 98 |
| | | | | | | | 99 |

Figure 46. INPUT TWO INDEPENDENT VARIABLES Function Option to Choose Input Values in Percentiles or in Engineering Unit.

screen contains a column of alternative units of measurement, labeled "AVBL UNITS", and a column of percentile names, labeled "AVBL PCTL", for which values can be obtained from the selected survey member.

The program places realistic constraints on the second variable, so the variable chosen first must be the most important one. For example, if the length dimension is more important than the weight, a length related variable must be selected first. Based on the value of the first entry, the second entry is constrained within a certain range as displayed in the information area of Figure 50. This range is set at $\pm 1.65$ standard deviations from the best estimate derived from the first value entered. This represents a 5th to 95th percentile range.

The next message is "DO YOU WANT VALUES IN PERCENTILES? ENTER Y/N" (see Figure 46). If the answer is "YES" you may enter either "YES" or "Y" or merely depress the CR key (since "YES" is the default choice). Values will be input by light-penning percentiles from the column "AVBL PCTL". The sequence is shown in Figures 47, 48, 49, and 50. If the response is "NO" or "N", values for the selected variables will be entered in engineering units using the alphanumeric keyboard. For values to be input as percentiles, Table 1 shows the sequence of displayed messages and user responses to be followed. If the values are supplied through the alphanumeric keyboard, the user should use Table 2 as a guide to the sequence of system messages and user responses. Once all the values are supplied, the program displays the COMBIMAN.

LIGHT-PEN FIRST INDEPENDENT VARIABLE

SURVEY MEMBER R67 USAF

| INDEPENDENT VARIABLES<br>MASS RELATED | UNIT | INPUT | LENGTH RELATED | UNIT | INPUT | AVBL UNITS | AVBL PCTL |
|---|---|---|---|---|---|---|---|
| WEIGHT | LB | | SITTING HEIGHT | IN | | IN | 1 |
| | | | | | | | 2 |
| BIDELTOID BRDTH | IN | | EYE HGT/SITTING | IN | | CM | 3 |
| | | | | | | | 5 |
| HIP BREADTH/SITT | IN | | ARM LENGTH | IN | | MM | 10 |
| | | | | | | | 15 |
| CHEST DEPTH | IN | | THUMB-TIP REACH | IN | | LB | 20 |
| | | | | | | | 25 |
| | | | KNEE HGT/SITTING | IN | | KG | 30 |
| | | | | | | | 35 |
| | | | BUTTOCK-KNE LGTH | IN | | | 40 |
| | | | | | | | 45 |
| | | | LEG LENGTH | IN | | | 50 |
| | | | | | | | 55 |
| | | | | | | | 60 |
| | | | | | | | 65 |
| | | | | | | | 70 |
| | | | | | | | 75 |
| | | | | | | | 80 |
| | | | | | | | 85 |
| | | | | | | | 90 |
| | | | | | | | 95 |
| | | | | | | | 97 |
| | | | | | | | 98 |
| | | | | | | | 99 |

Figure 47. INPUT TWO INDEPENDENT VARIABLES Function Light Pen First Independent Variable.

LIGHT-PEN PERCENTILE

SURVEY MEMBER R67 USAF

INDEPENDENT VARIABLES

| MASS RELATED | UNIT | INPUT | LENGTH RELATED | UNIT | INPUT | AVBL UNITS | AVBL PCTL |
|---|---|---|---|---|---|---|---|
| WEIGHT | LB | | SITTING HEIGHT | IN | | IN | 1 |
| | | | | | | | 2 |
| BIDELTOID BRDTH | IN | | EYE HGT/SITTING | IN | | CM | 3 |
| | | | | | | | 5 |
| HIP BREADTH/SITT | IN | | ARM LENGTH | IN | | MM | 10 |
| | | | | | | | 15 |
| CHEST DEPTH | IN | | THUMB-TIP REACH | IN | | LB | 20 |
| | | | | | | | 25 |
| | | | KNEE HGT/SITTING | IN | | KG | 30 |
| | | | | | | | 35 |
| | | | BUTTOCK-KNE LGTH | IN | | | 40 |
| | | | | | | | 45 |
| | | | LEG LENGTH | IN | | | 50 |
| | | | | | | | 55 |
| | | | | | | | 60 |
| | | | | | | | 65 |
| | | | | | | | 70 |
| | | | | | | | 75 |
| | | | | | | | 80 |
| | | | | | | | 85 |
| | | | | | | | 90 |
| | | | | | | | 95 |
| | | | | | | | 97 |
| | | | | | | | 98 |
| | | | | | | | 99 |

Figure 48. INPUT TWO INDEPENDENT VARIABLE Function Light Pen Percentile for First Independent Variable.

LIGHT-PEN VARIABLE IN OTHER COLUMN

SURVEY MEMBER R67 USAF

INDEPENDENT VARIABLES

| MASS RELATED | UNIT | INPUT | LENGTH RELATED | UNIT | INPUT | AVBL UNITS | AVBL PCTL |
|---|---|---|---|---|---|---|---|
| WEIGHT | LB | | SITTING HEIGHT | IN | 50 PCT | IN | 1 |
| BIDELTOID BRDTH | IN | | EYE HGT/SITTING | IN | | CM | 2 |
| | | | | | | | 3 |
| HIP BREADTH/SITT | IN | | ARM LENGTH | IN | | MM | 5 |
| | | | | | | | 10 |
| CHEST DEPTH | IN | | THUMB-TIP REACH | IN | | LB | 15 |
| | | | | | | | 20 |
| | | | KNEE HGT/SITTING | IN | | KG | 25 |
| | | | | | | | 30 |
| | | | BUTTOCK-KNE LGTH | IN | | | 35 |
| | | | | | | | 40 |
| | | | LEG LENGTH | IN | | | 45 |
| | | | | | | | 50 |
| | | | | | | | 55 |
| | | | | | | | 60 |
| | | | | | | | 65 |
| | | | | | | | 70 |
| | | | | | | | 75 |
| | | | | | | | 80 |
| | | | | | | | 85 |
| | | | | | | | 90 |
| | | | | | | | 95 |
| | | | | | | | 97 |
| | | | | | | | 98 |
| | | | | | | | 99 |

Figure 49. INPUT TWO INDEPENDENT VARIABLE Function Light Pen the Second Independent Variable.

LIGHT-PEN PERCENTILE WITHIN RANGE

SELECT A VALUE BETWEEN 5 AND 95 PCT

INDEPENDENT VARIABLES

| MASS RELATED | UNIT | INPUT | LENGTH RELATED | UNIT | INPUT | AVBL UNITS | AVBL PCTL |
|---|---|---|---|---|---|---|---|
| WEIGHT | LB | | SITTING HEIGHT | IN | 50 PCT | IN | 1 |
| | | | | | | | 2 |
| BIDELTOID BRDTH | IN | | EYE HGT/SITTING | IN | | CM | 3 |
| | | | | | | | 5 |
| HIP BREADTH/SITT | IN | | ARM LENGTH | IN | | MM | 10 |
| | | | | | | | 15 |
| CHEST DEPTH | IN | | THUMB-TIP REACH | IN | | LB | 20 |
| | | | | | | | 25 |
| | | | KNEE HGT/SITTING | IN | | KG | 30 |
| | | | | | | | 35 |
| | | | BUTTOCK-KNE LGTH | IN | | | 40 |
| | | | | | | | 45 |
| | | | LEG LENGTH | IN | | | 50 |
| | | | | | | | 55 |
| | | | | | | | 60 |
| | | | | | | | 65 |
| | | | | | | | 70 |
| | | | | | | | 75 |
| | | | | | | | 80 |
| | | | | | | | 85 |
| | | | | | | | 90 |
| | | | | | | | 95 |
| | | | | | | | 97 |
| | | | | | | | 98 |
| | | | | | | | 99 |

Figure 50. INPUT TWO INDEPENDENT VARIABLE Function Light Pen Percentile for the Second Independent Variable Within Range.

TABLE 1

PROGRAM MESSAGES AND USER RESPONSES FOR PFK13
WHEN VALUES WILL BE INPUT AS PERCENTILES

(Program Responses Are Listed in Parenthesis)

| PROGRAM MESSAGES | USER RESPONSES |
|---|---|
| LIGHT-PEN FIRST INDEP. VARIABLE | Light pen a variable from either mass or length column. See Figure 47. (Selected variable will be underlined by program.) |
| LIGHT-PEN PERCENTILE | Light pen percentile number from the column "AVBL PCTL". (Selected percentile will be displayed next to underlined variable.) |
| LIGHT-PEN VBL IN OTHER COLUMN | Light pen a variable from the column not selected the first time. See Figure 49. (Selected variable will be underlined, if it is in the other column, and a permissible range of percentile values will be displayed in the information area. See Figure 50.) |
| LIGHT-PEN PCTL WITHIN RANGE | Light pen a percentile number from the column "AVBL PCTL" which lies within the range of values displayed. (Selected percentile will be checked and displayed next to underline variable.) |

TABLE 2

PROGRAM MESSAGES AND USER RESPONSES FOR PFK13 WHEN VALUES WILL BE INPUT AS ABSOLUTE DIMENSIONS

(Program Responses Are Listed in Parenthesis)

| PROGRAM MESSAGES | USER RESPONSES |
|---|---|
| 1. DO YOU WANT VALUES IN PCTLS? ENTER Y/N | Enter "NO" or "N" through the ANKB and depress CR key. "YES" is the default value. |
| 2. DO YOU WANT TO CHANGE UNIT? ENTER Y/N | If input units are other than inches and pounds, enter "YES" or "Y" through the ANKB and depress CR key. "NO" is the default value. |
| 3. LIGHT-PEN FIRST INDEP. VARIABLE | Light-pen a variable from either mass or length column. (Selected variable is underlined.) |
| 4. LIGHT-PEN NEW UNIT, IF DESIRED (If response to message 2 is "YES".) | If a unit of measurement other than the one listed next to the underlined variable is desired, light pen a new unit from the column "AVBL UNITS". If no change is desired, press CR key.<br><br>The system checks that the unit is valid for the type of variable and displays it next to the input value. It also checks for the value to be within range for the selected survey. |
| 5. ENTER NEW VALUE | Type in real number value through the ANKB and depress CR key. (Typed value will be displayed next to underlined variable.) |
| 6. LIGHT-PEN VARIABLE IN OTHER COLUMN | Light pen a variable from the column not selected the first time.<br>Selected variable will be underlined if it is in the proper column. |
| 7. LIGHT-PEN NEW UNIT, IF DESIRED (If response to message 2 is "YES".) | Light pen a new unit or depress CR key for default unit. The system checks the unit, computes the range and displays the values in the information area. |
| 8. ENTER NEW VALUE | Type in real number value within the displayed range, through the ANKB and depress CR key.<br>(Typed value will be verified and displayed next to the underlined variable.) |

### 2.2.14 DISPLAY LINK TABLE Function (PFK14)

The DISPLAY LINK TABLE function provides the user with the opportunity to inspect the table of link dimensions and angles and make changes to any or all of the values, if necessary. Since the table displays internal link vector lengths rather than the anthropometric surface dimensions, the user should make changes in the vector lengths with caution, because unrealistic body proportions may result. Unrealistic joint angles will produce unrealistic displays. Figure 51 shows an example of a Display Table.

The user can modify the values in the Display Table by light-penning the value to be changed, typing a new value, and depressing the CR key (see Figure 52). When all desired changes are made, the user depresses the CR key again to display the new man-model. The transformation angles in this display can be modified to place the man-model in any desired position (see Paragraph 2.2.24).

Other than the choices of slumped or erect posture, and the reposturing in the reach analysis, using the LINK TABLE to change the joint angles is the user's most important method to change the body position of the man-model. To properly use this table, refer to Table 3 for all link definitions.

Any changes made in the LINK TABLE are automatically saved and may be recalled by the RESET PROGRAMMED POSTURE function, PFK25 (see Paragraph 2.2.24). So if you manually reposition the orientation angles, and then change them using the ERECT POSTURE, SLUMPED POSTURE, or PERFORM REACH, you can recall your own posture by depressing PFK25.

As described in Section 1, the link system is a series of vectors added together. Each link vector has a local coordinate system with its origin at the distal end. The orientation of the next link is defined in this local coordinate system. The Phi, Theta, and Psi correspond to Euler angles as

LIGHT-PEN VALUE YOU WANT TO CHANGE

| --LINK-- | LENGTH | -PHI- | -THETA- | -PSI- |
|---|---|---|---|---|
| SRP | Ø Ø | Ø Ø | Ø Ø | Ø Ø |
| SRP-MHIP | 5 75 | Ø Ø | 46 2Ø | Ø Ø |
| MHIP-L34 | 5 18 | Ø Ø | -67 2Ø | Ø Ø |
| CHEST | 9 47 | Ø Ø | 4 8Ø | Ø Ø |
| T89-T1 | 7 49 | Ø Ø | 1Ø ØØ | Ø Ø |
| NECK | 5 21 | Ø Ø | 2Ø ØØ | Ø Ø |
| NECK-MHD | 1 4Ø | Ø Ø | -14 3Ø | Ø Ø |
| MHD-MEYE | 3 34 | Ø Ø | 9Ø ØØ | Ø Ø |
| MEYE-REY | 1 25 | -9Ø ØØ | 9Ø ØØ | Ø Ø |
| MEYE-LEY | 1 25 | 9Ø ØØ | 9Ø ØØ | Ø Ø |
| T1-MSS | 3 23 | Ø Ø | 115 ØØ | Ø Ø |
| MSS-RSS | 1 ØØ | -9Ø ØØ | 9Ø ØØ | 29 3Ø |
| RSS-RSLD | 8 26 | 35 ØØ | 22 ØØ | Ø Ø |
| RSLDR | Ø Ø | Ø Ø | -22 ØØ | -125 ØØ |
| RUPARM | 1Ø 93 | Ø Ø | -9Ø ØØ | -9Ø ØØ |
| RLWARM | 1Ø 56 | Ø Ø | 9Ø ØØ | Ø Ø |
| RGRIP | 2 ØØ | Ø Ø | Ø Ø | Ø Ø |
| RFNRCH | 4 69 | Ø Ø | Ø Ø | Ø Ø |
| RFNGRTIP | 7 52 | Ø Ø | Ø Ø | Ø Ø |
| MSS-LSS | 1 ØØ | 9Ø ØØ | 9Ø ØØ | -29 3Ø |
| LSS-LSLD | 8 26 | -35 ØØ | 22 ØØ | Ø Ø |
| LSLDR | Ø Ø | Ø Ø | -22 ØØ | 125 ØØ |
| LUPARM | 1Ø 93 | Ø Ø | -9Ø ØØ | 9Ø ØØ |
| LLWRARM | 1Ø 56 | Ø Ø | 9Ø ØØ | Ø Ø |
| LGRIP | 2 ØØ | Ø Ø | Ø Ø | Ø Ø |
| LFNRCH | 4 69 | Ø Ø | Ø Ø | Ø Ø |
| LFNGRTIP | 7 52 | Ø Ø | Ø Ø | Ø Ø |
| MHIP-RHP | 3 43 | -9Ø ØØ | 9Ø ØØ | 53 7Ø |
| RUPRLEG | 17 Ø2 | 84 ØØ | 9Ø ØØ | -9Ø ØØ |
| RLWRLEG | 16 15 | Ø Ø | 6Ø ØØ | Ø Ø |
| RANKLE | 2 21 | Ø Ø | Ø Ø | Ø Ø |
| MHIP-LHP | 3 43 | 9Ø ØØ | 9Ø ØØ | -53 7Ø |
| LUPRLEG | 17 Ø2 | -84 ØØ | 9Ø ØØ | 9Ø ØØ |
| LLWRLEG | 16 15 | Ø Ø | 6Ø ØØ | Ø Ø |
| LANKLE | 2 21 | Ø Ø | Ø Ø | Ø Ø |

**Figure 51.** **DISPLAY LINK TABLE Display Links, Their Lengths and Euler Angles.**

ENTER NEW VALUE
0_

| --LINK-- | LENGTH | -PHI- | -THETA- | -PSI- |
|---|---|---|---|---|
| SRP | 0 0 | 0 0 | 0 0 | 0 0 |
| SRP-MHIP | 5 75 | 0 0 | 46 20 | 0 0 |
| MHIP-L34 | 5 18 | 0 0 | -67 20 | 0 0 |
| CHEST | 9 47 | 0 0 | 4 80 | 0 0 |
| T89-T1 | 7 49 | 0 0 | 10 00 | 0 0 |
| NECK | 5 21 | 0 0 | 20 00 | 0 0 |
| NECK-MHD | 1 40 | 0 0 | -14 30 | 0 0 |
| MHD-MEYE | 3 34 | 0 0 | 90 00 | 0 0 |
| MEYE-REY | 1 25 | -90 00 | 90 00 | 0 0 |
| MEYE-LEY | 1 25 | 90.00 | 90 00 | 0 0 |
| T1-MSS | 3 23 | 0 0 | 115 00 | 0 0 |
| MSS-RSS | 1 00 | -90 00 | 90 00 | 29 30 |
| RSS-RSLD | 8 26 | 35 00 | 22 00 | 0 0 |
| RSLDR | 0 0 | 0 0 | -22 00 | -125 00 |
| RUPARM | 10 93 | 0 0 | -90 00 | -90 00 |
| RLWARM | 10 56 | 0 0 | 90 00 | 0 0 |
| RGRIP | 2 00 | 0.0 | 0 0 | 0 0 |
| RFNRCH | 4 69 | 0 0 | 0 0 | 0 0 |
| RFNGRTIP | 7 52 | 0 0 | 0 0 | 0 0 |
| MSS-LSS | 1 00 | 90 00 | 90 00 | -29 30 |
| LSS-LSLD | 8 26 | -35 00 | 22 00 | 0 0 |
| LSLDR | 0 0 | 0 0 | -22 00 | 125 00 |
| LUPARM | 10 93 | 0 0 | -90.00 | 90 00 |
| LLWRARM | 10 56 | 0 0 | 90 00 | 0 0 |
| LGRIP | 2 00 | 0 0 | 0 0 | 0 0 |
| LFNRCH | 4.69 | 0 0 | 0 0 | 0 0 |
| LFNGRTIP | 7 52 | 0 0 | 0 0 | 0 0 |
| MHIP-RHP | 3 43 | -90 00 | 90 00 | 53 70 |
| RUPRLEG | 17 02 | 84 00 | 90.00 | -90 00 |
| RLWRLEG | 16 15 | 0 0 | 60 00 | 0 0 |
| RANKLE | 2 21 | 0 0 | 0 0 | 0 0 |
| MHIP-LHP | 3.43 | 90 00 | 90 00 | -53 70 |
| LUPRLEG | 17 02 | -84 00 | 90 00 | 90 00 |
| LLWRLEG | 16 15 | 0 0 | 60 00 | 0 0 |
| LANKLE | 2 21 | 0 0 | 0 0 | 0 0 |

Figure 52. **DISPLAY LINK TABLE Change THETA Value of LLWRLEG from 60° to 0°. One Carriage Return Enters the Value, a Second CR Displays the COMBIMAN.**

TABLE 3

LINK SYSTEM DEFINITION

| LINK NO. | NAME | DEFINITION |
|---|---|---|
| 1 | SRP | Zero-length link at the Seat Reference Point for orientation |
| 2 | SRP-MHIP | SRP to mid-hip |
| 3 | MHIP-L34 | Mid-hip to L3/L4 disc |
| 4 | CHEST | L3/L4 disc to T8/T9 disc |
| 5 | T89-T1 | T8/T9 disc to T1 vertebra |
| 6 | NECK | T1 vertebra to atlas |
| 7 | NECK-MHD | Atlas to mid-head point |
| 8 | MHD-MEYE | Mid-head point to mid-eye point |
| 9 | MEYE-REY | Mid-eye point to right eye |
| 10 | MEYE-LEY | Mid-eye point to left eye |
| 11 | T1-MSS | T1 vertebra to mid-suprasternale |
| 12 | MSS-RSS | Mid-suprasternale to right suprasternale |
| 13 | RSS-RSLD | Right suprasternale to right shoulder |
| 14 | RSLDR | Zero-length link at the right shouder for orientation |
| 15 | RUPARM | Right shoulder to right elbow |
| 16 | RLWARM | Right elbow to right wrist |
| 17 | RGRIP | Right wrist to grip center point |
| 18 | RFNRCH | Right grip center point to functional reach point |
| 19 | RFNGRTIP | Right functional reach point to fingertip reach point |
| 20 | MSS-LSLD | Mid-suprasternale to left shoulder |
| 21 | LSS-LSLD | Left suprasternale to left shoulder |
| 22 | LSLDR | Zero-length link at the left shoulder for orientation |
| 23 | LUPRARM | Left shoulder to left elbow |
| 24 | LLWRARM | Left elbow to left wrist |
| 25 | LGRIP | Left wrist to grip center point |
| 26 | LFNRCH | Left grip center point to functional reach point |
| 27 | LFNGRTIP | Left functional reach point to fingertip reach point |
| 28 | MHIP-RHP | Mid-hip to right hip |
| 29 | RUPRLEG | Right hip to right knee |
| 30 | RLWRLEG | Right knee to right ankle |
| 31 | RANKLE | Right ankle to bottom of the right foot |
| 32 | MHIP-LHP | Mid-hip to left hip |
| 33 | LUPRLEG | Left hip to left knee |
| 34 | LLWRLEG | Left knee to left ankle |
| 35 | LANKLE | Left ankle to bottom of left foot |

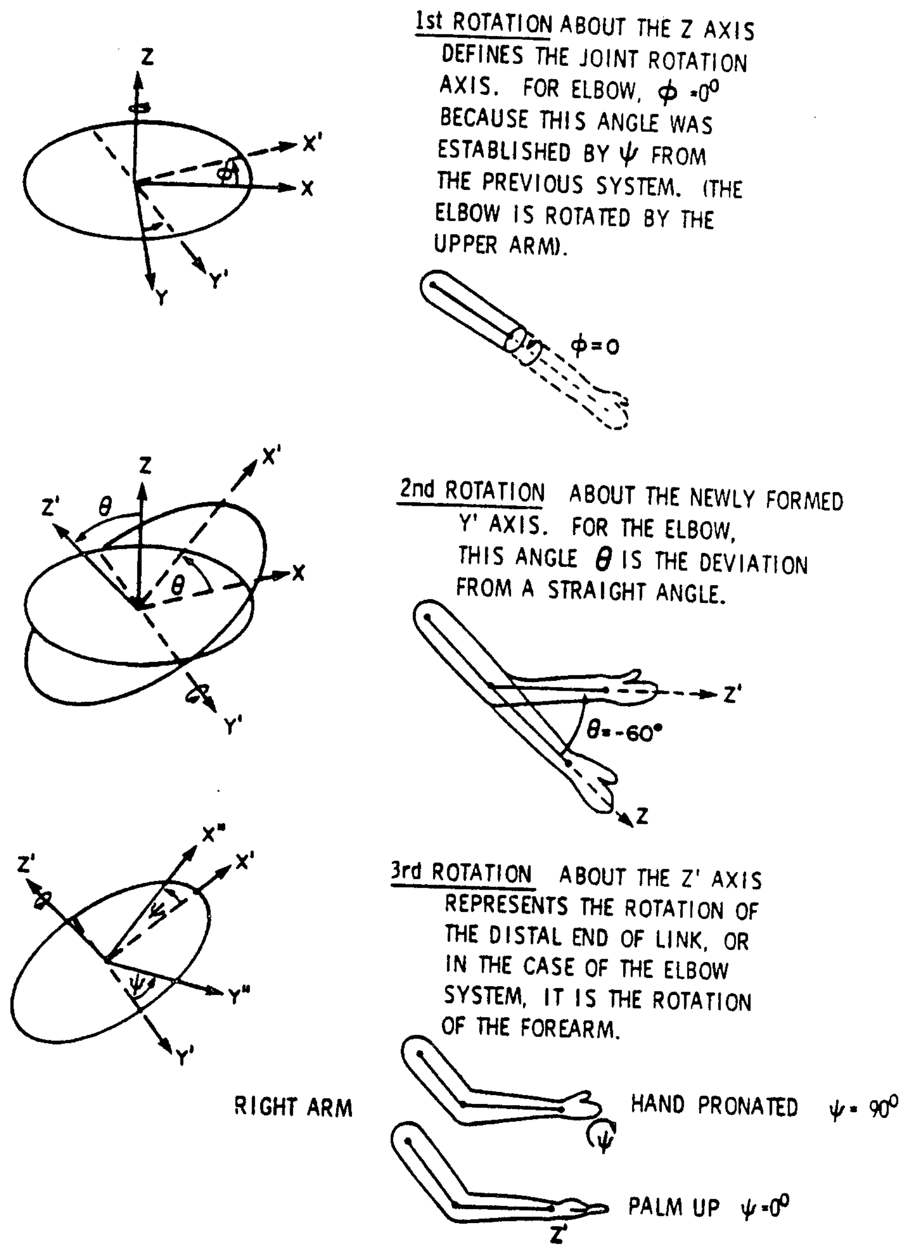



Figure 53. Example of Euler Angle Changes for Elbow Joints.

shown in Figure 53. Since these local coordinate systems are usually not aligned with the base system which has its origin at SRP, no rule can be given for selecting a particular direction of movement. The user should try angular changes one-by-one to obtain desired results.

Any change made in link length is reflected in the man-model for all postures. However, changes made in angles are reflected only in PROGRAMMED Posture.

### 2.2.15 DESIGN PANEL Function (PFK16)

The DESIGN PANEL function allows the user to add a panel to an existing crew station, or design a new crew station by assembling a series of new panels. In response to prompting message "ENTER PANEL NAME" the user must type a panel name of up to eight characters and enter it by depressing the CR key. To the prompting message "ENTER PANEL TYPE" the user should enter a type number "1" for general crew station, "2" for seat panel, and "3" for rudder or brake pedal. Finally, as a response to the message "ENTER NUMBER OF VERTICES" the user must supply a number in the range of 1 to 25. Then with the cross symbol "+" and the lighted PFKs, the user defines the X, Y, and Z coordinates and the vertices of the panel, one at a time, using the method described in Paragraph 2.2.11.1.

As mentioned in Paragraph 2.2.11, PFK12 is used to stop the "+" while in motion. When PFK31 is depressed the location of the vertex is defined in the displayed view. When subsequent vertices are defined, they are automatically connected by lines.

The panel thus defined can be treated like any other panel. It will not, however, be automatically added to the permanent Crew Station Data Base.

The newly designed panel name and coordinates will appear on the printout as shown in Figure 54. The user can enter these as a permanent part of the Crewstation Data Base using the method described in Section 5.

The panel will be removed from the crew station display when the "ERASE" option of the RETRIEVE CREW STATION function is selected.

```
1CJM001I COMBIMAN V6, DATE= 7/11/83, TIME=13.13.38.
 CBMC09I SWITCH 24 ON
 CBM033I REGRESSION VALUES FROM MEMBER R67 USAF.
 CBM015I SURVEY DATA FROM 67 USAF
 CBMC45I USER INPUTS 2 INDEPENDENT VARIABLES
 CBM041I INPUT VARIABLES ARE IN PERCENTILES
 SITTING HEIGHT     40 PCT   36.33 IN
 WEIGHT             45 PCT  169.74 LB
 COMPUTED ANTHROPOMETRIC DIMENSIONS
 NO.    VARIABLE NAME    VALUE  UNIT
  1   WEIGHT            169.74 LB
  2   SITTING HEIGHT     36.33 IN
  3   ACROMION HGT/SIT   23.78 IN
  4   KNEE HGT/SITTING   21.81 IN
  5   BUTTOCK-KNE LGTH   23.66 IN
  6   SHOULDR-ELB LGTH   14.06 IN
  7   BIACROMIAL BRDTH   15.94 IN
  8   HIP BREADTH        13.77 IN
  9   CHEST DEPTH         9.59 IN
 10   FOOT LENGTH        10.57 IN
 11   HAND LENGTH         7.48 IN
 12   ELBOW-WRIST LGTH   11.74 IN
 CBM014I C/S DATA FROM A7E-01
 CBM007I  82. PANEL NAME: NEWPNL   , TYPE= 1, 4 VERTICES
         23.30   0.0  21.30    22.40  0.0  15.30    22.40  7.00 15.30    29.40  7.00 13.30
 CBM048I DATA WRITTEN FOR OFF-LINE PLOT NO. 1.
 CBM048I DATA WRITTEN FOR OFF-LINE PLOT NO. 2.
 CBMC09I SWITCH 19 ON
 CBM052I VISIBILITY PLOT GENERATED FOR A7E-01
 CBM009I SWITCH 16 ON
 CBMC09I SWITCH 16 ON
 CBMC09I SWITCH 20 ON
 CBM052I VISIBILITY PLOT GENERATED FOR A7E-01
 CBMC02I PROGRAM END
```

Figure 54. Printed Output of the Newly Designed Panel NEWPNL is Within the Box.

NOTE: There are two options available and they are selected by state switch 23; OFF - the program defaults to 3-6 vertices, if ON - the program defaults to 1-25 vertices. The larger number of vertices are useful for representing panels with curved surfaces.

*The program assigns the lowest unused sequence number as the "internal reference number" for this new panel.

### 2.2.16 DELETE PANEL Function (PFK18)

The DELETE PANEL function allows the user to temporarily remove a crew station panel from the display. It does not remove the panel from the Crew Station Data Base. Once deleted, the panel can be recalled using RETRIEVE CREW STATION function in Paragraph 2.2.6.

To delete a panel, the name of the panel must be entered through the ANKB as response to prompting message "ENTER PANEL NAME". If the specified panel does not exist, the program repeats the prompt until the user specifies an existing panel, or depresses the CR key. If no name is specified by depressing the CR key the function request is ignored and no deletion occurs. The panel name can be found with the IDENTIFY OBJECT function described in Paragraph 2.2.2.

The DELETE PANEL function is different from the OMIT OBJECT function because this function deletes the panel from the display and cannot be redisplayed by invoking the INCLUDE OBJECT function, or the CHANGE VIEW function.

### 2.2.17 STRENGTH ANALYSIS Function (PFK19)

The STRENGTH ANALYSIS function computes and displays the amount of strength a crewmember can exert on a control. Available strength depends not only on the muscular strength characteristics of a person or a population, but also on task related factors such as location of the control relative to the operator's location and body size, the direction of the force exerted, acceleration forces and the duration of the exertion. Acceleration and endurance effects have not yet been incorporated into the COMBIMAN. Reference Appendix D. Flow diagram for the STRENGTH ANALYSIS function (PFK19).

The data modeled in this function represents male and female USAF crewmembers only. Similar strength data is currently unavailable for the Army and Navy populations and the STRENGTH ANALYSIS function cannot be selected if these populations were used to define the body size. The strength data is for short (5 second) static exertions. Two data bases have been combined to represent most locations reachable in a crewstation, however, it is possible for the user to cause the COMBIMAN to reach outside the strength data base. If you do this, the program will stop and give you a message to that effect.

One of the modeled data bases represents male and female pilots operating traditional aircraft controls: stick and wheel type aileron and elevator, and rudder pedals. A second data base represents maximum forces up, down, left, right, fore, and aft for 76 different handle locations within the seated crewstation, locations which cover the forward area above the seat reference point level. The STRENGTH ANALYSIS function interpolates between these locations to provide the best estimate of strength for any point the user selects. These data bases have been merged in such a way that the user only gets the results for a specific location, gender, and type of control specified. So, if the user changes the control location, or the direction of force applied, the results will be different. The results are forces in pounds representing the 1st, 5th, 50th,

95th, and 99th percentiles of USAF male and female pilots (see Figure 55).

Because the variables of body size and strength are not highly correlated, they are treated independently in this strength analysis program. In other words, defining a larger body size for the COMBIMAN will not be itself produce a greater strength. The strengths displayed represent the population as a whole and not the body size the user has defined. One factor that does effect strength, however, is the location and orientation of the control relative to the operator's orientation. So, body size is somewhat considered in that the same control will have a slightly different relative location for small and large operators.

For the Lever control, not only is the resultant force (Fmag) displayed, but also the X, Y, and Z components (relative to the COMBIMAN SRP coordinates) of that resultant force (see Figure 56). These are useful for understanding the extraneous forces that operators exert on controls. For example, if you ask a person to lift up a control handle, the person may also exert a lateral and longitudinal force because of the relationship of the shoulder or seat support relative to the control resistance. These forces are smaller in magnitude than the resultant, but should be considered if the control is sensitive in other axes or if the control is not strong in other axes. By providing these components, the user can compute the direction of the resultant, if desired.

The design philosophy is to accommodate the 5th percentile male or female strength capability as appropriate, and to accommodate the 1st percentile strength capability where critical functions are involved. The upper percentiles of strength are not useful as operator performance limits, but may be useful in designing the "break strength" of controls.

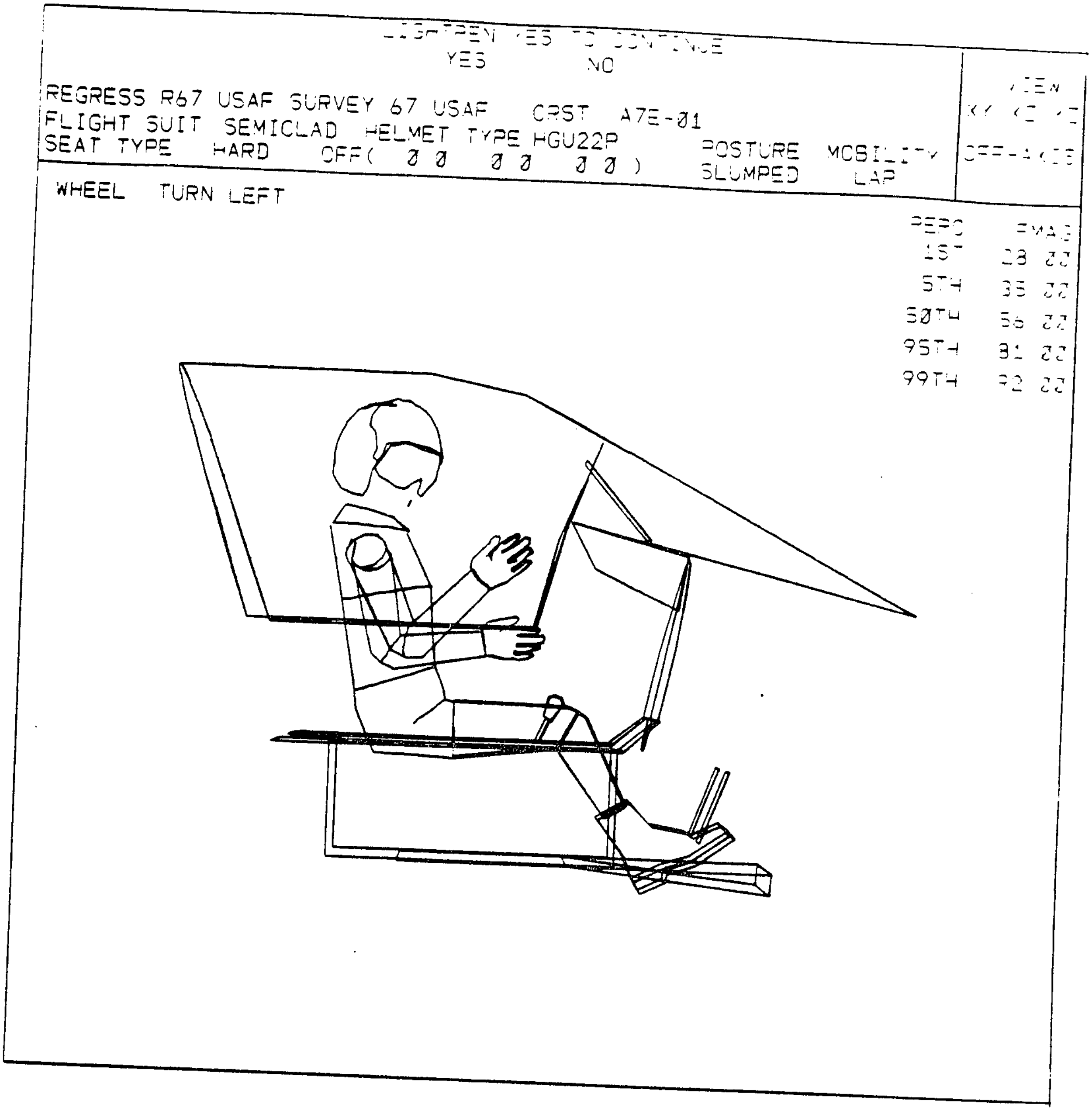



Figure 55. Force Magnitude for Stick Wheel or Pedal.

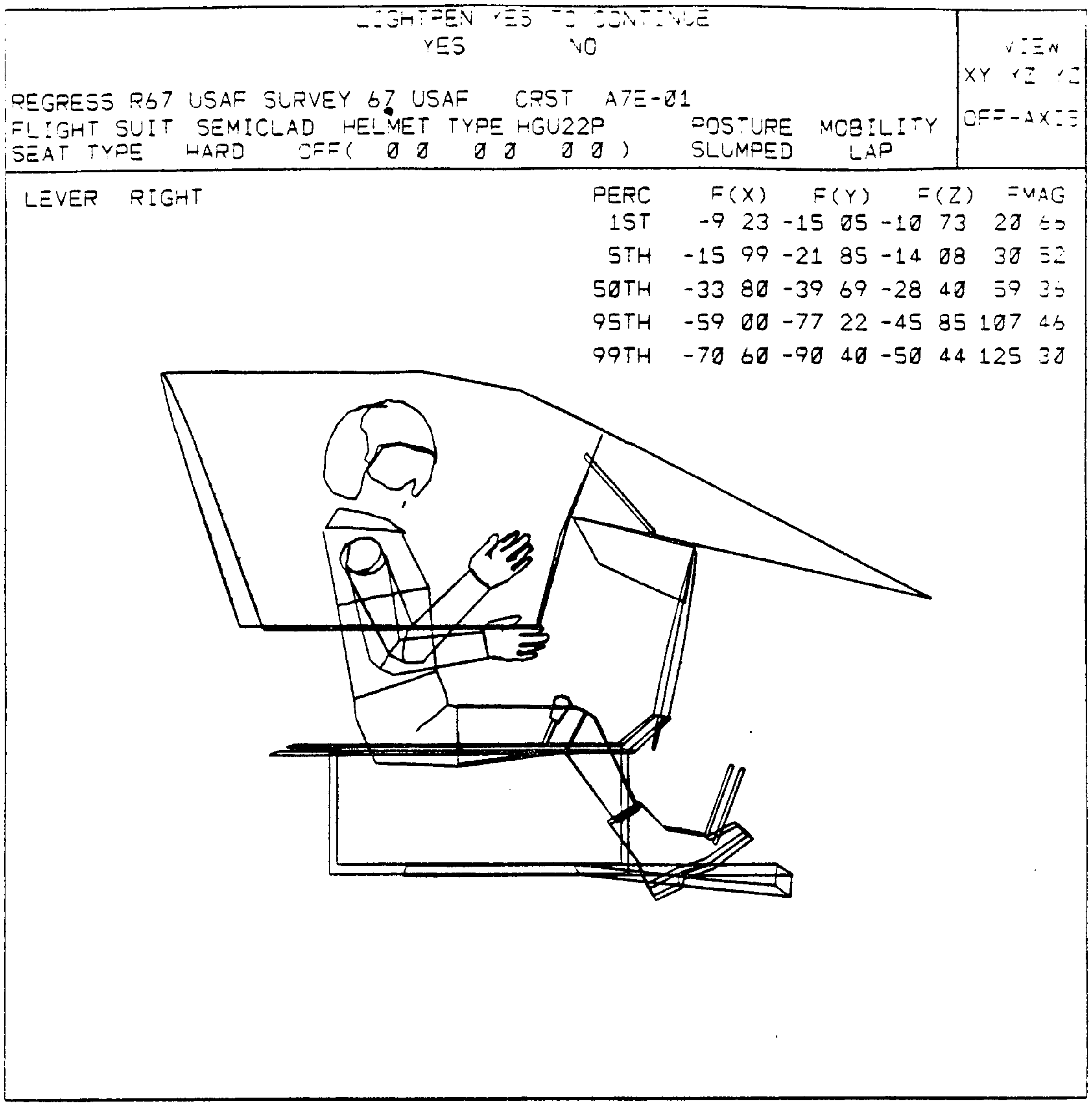



Figure 56. Force Vectors and Magnitudes for Lever.

The first step in the strength analysis is the familiar reach analysis (PFK11). One cannot exert a force on a control that one cannot reach. The reach part of the strength analysis is also necessary to get the location of the control relative to the operator. The point to be reached does not have to be a predefined control, although it can be (the Rudder Pedal must be pre-defined). Usually, however, it is a point in space where the designer would like to locate a control. Also, the control may have a range of movement, with variable resistance at different displacements within that range of movement. The user may wish to evaluate strength capability at the extremes as well as the middle of the range of displacement.

STEP 1 - Depress PFK19, STRENGTH ANALYSIS. This automatically begins the REACH ANALYSIS as described in Paragraph 2.2.11. The user should have the COMBIMAN reach to the control location with the desired limb. The user should refer to Paragraph 2.2.11 for instructions in performing the REACH ANALYSIS. When a "successful" REACH ANALYSIS is complete, proceed to Step 2.

STEP 2 - Select control type (see Figure 57). The control choices are LEVER, STICK, and WHEEL. (When performing a STRENGTH ANALYSIS of the leg, the control choice is defaulted to the rudder pedal.)

The Lever option can be operated by either the left or right hand only, not both. The lever is a vertical handgrip which can be located anywhere in the reach envelope above and forward of the seat reference point. If you select a point outside of the strength data base, the message "OUT OF RANGE FOR AVAILABLE STRENGTH DATA" (see Figure 58) followed by "DO YOU WANT TO RESET POSTURE". A "YES" answer returns the program to the beginning of the reach analysis. A "NO" answer terminates the StRENGTH ANALYSIS. Directions available include up, down, left, right, fore, and aft (see Figure 59). X, Y, and Z components will be displayed.

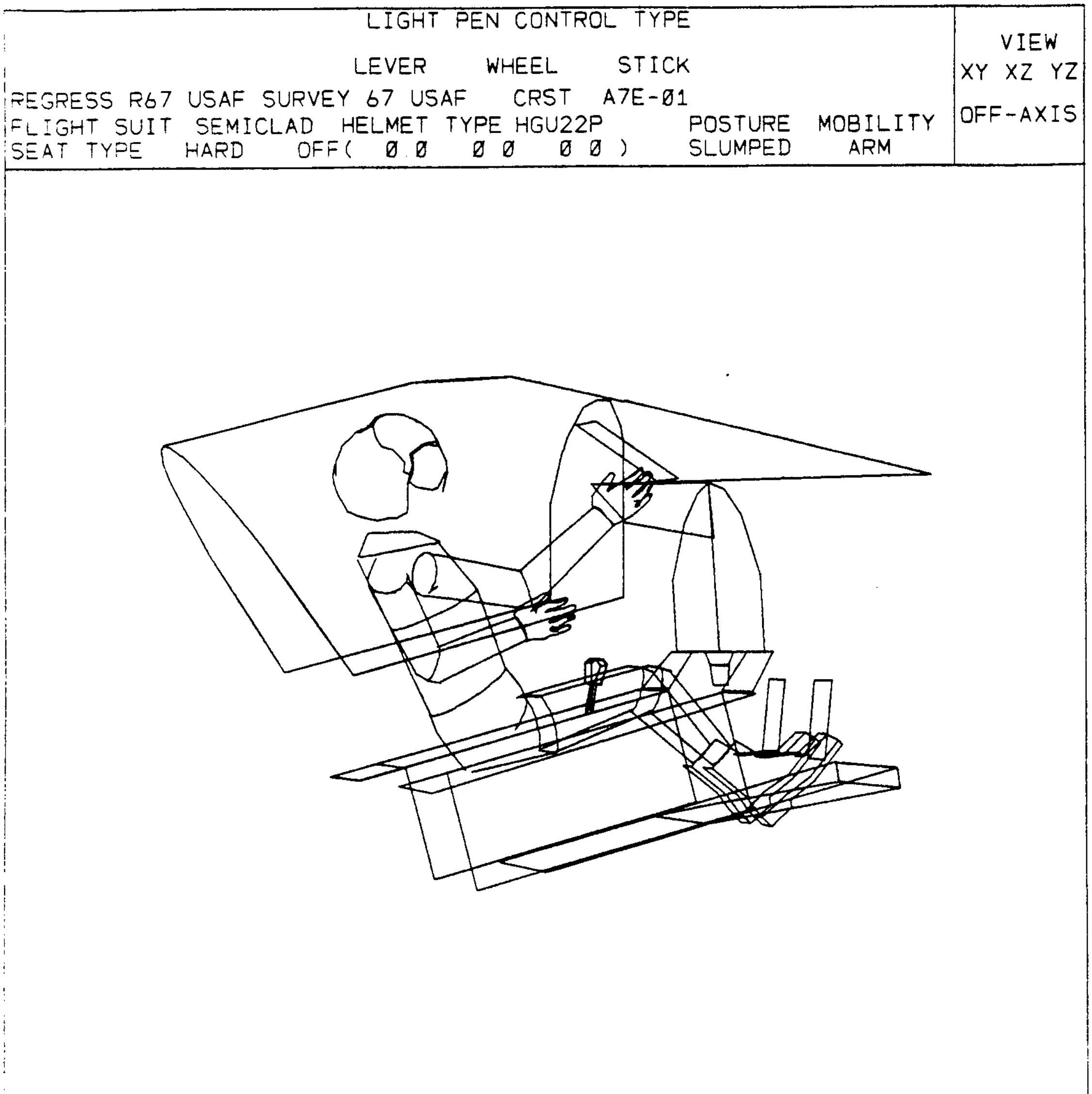



Figure 57. Light-Pen Control Type.

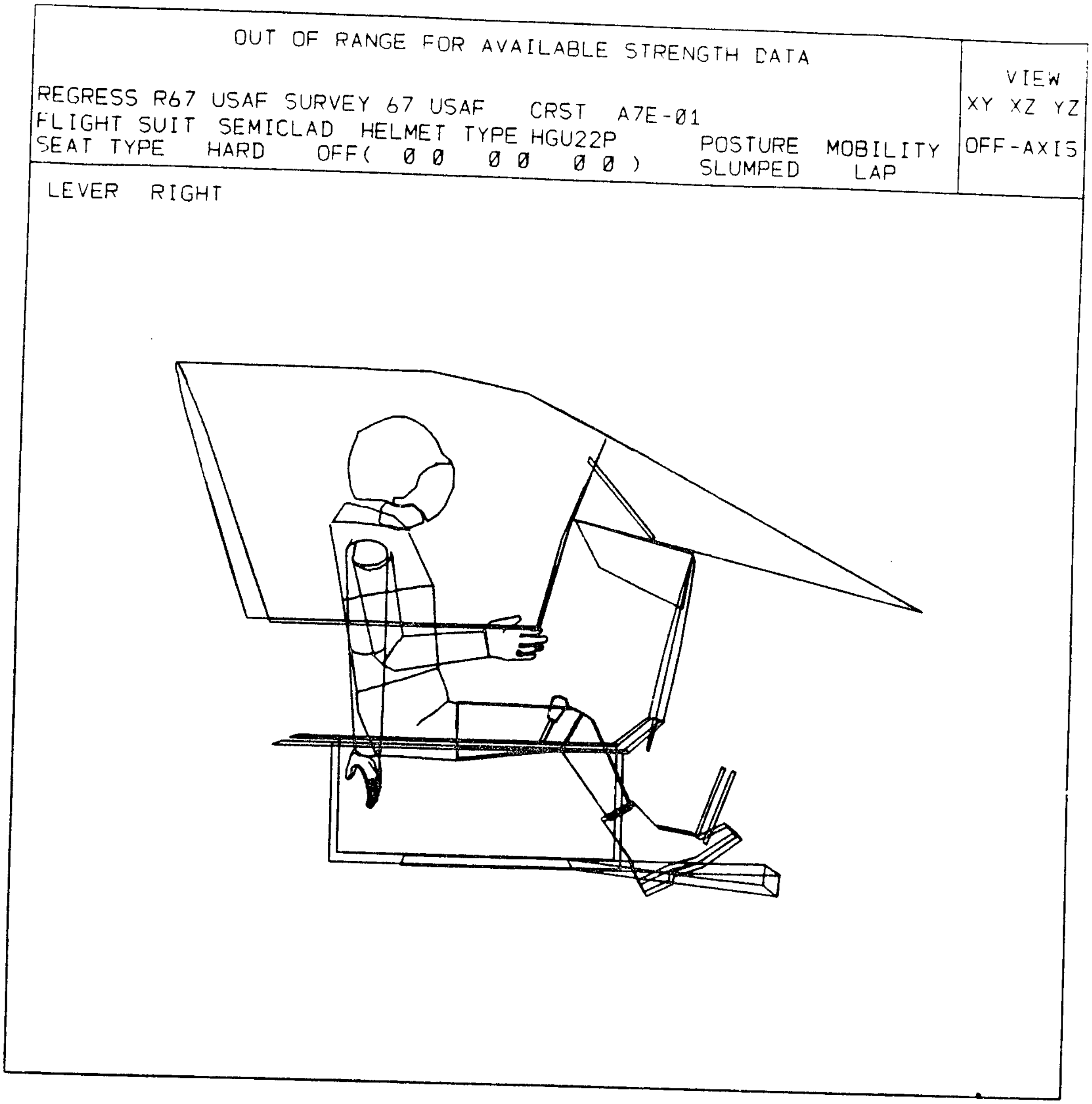



Figure 58. Out of Range for Available Strength Data.

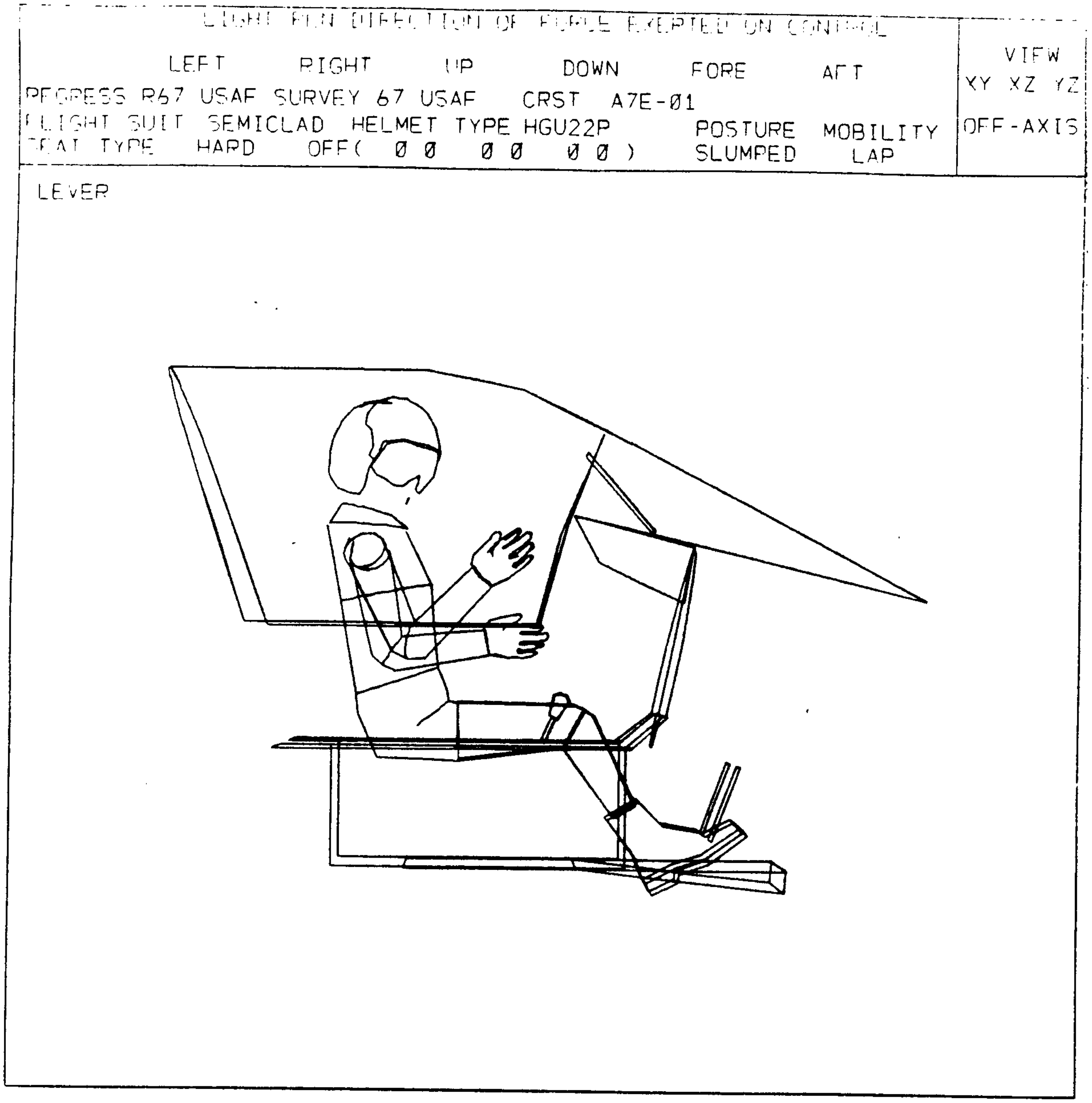



Figure 59. Light-Pen Direction of Force on Control.

The Stick option can be operated by either the right or left hand and represents a center-mounted aileron and elevator control stick. Directions available include fore, aft, left, and right.

The Wheel option can be operated with left, right, or both hands and represents a wheel or yoke type aileron and elevator control such as found in the large aircraft. Note that the measures are static and that the wheel remains in a horizontal position when the force is applied. The directions are FORE, AFT, TURN LEFT (counterclockwise) and TURN RIGHT (clockwise), see Figure 60. Thus, turning to the left with both hands means that the pilot is pulling downward with the left hand an upward with the right hand for control handles which do not move. For single hand operation of the wheel, TURN LEFT and TURN RIGHT directions correspond to vertical exertions on the handle.

The Rudder Pedal option is operated only for pushing forward with one foot (either left or right, but not both) and requires the pedal to have been defined as a pedal (panel type 3 as discussed in Paragraph 5.3.2.1) when the crew station data base was created. The strength data base is valid for pedal conditions with a 13 degree to 18 degree seat back angle, and a pedal location 5-1/2 to 10-1/2 inches below, and within leg reach, but not less than 24 inches forward, of the Seat Reference Point. Note that the pedal location is selected with the light pen in the foot reach analysis, rather than by positioning a cursor as with the hand operated controls.

STEP 3 - Uses the light-pen to select the direction of force (see Figure 59). The choices offered are as discussed in STEP 2 above.

STEP 4 - After selecting the control and direction, the program calculates the available strength as a function of control location and direction of the force and displays the 1st, 5th, 50th, 95th, and 99th percentile strength in the upper right corner of the display. The prompt message is "LIGHT-PEN

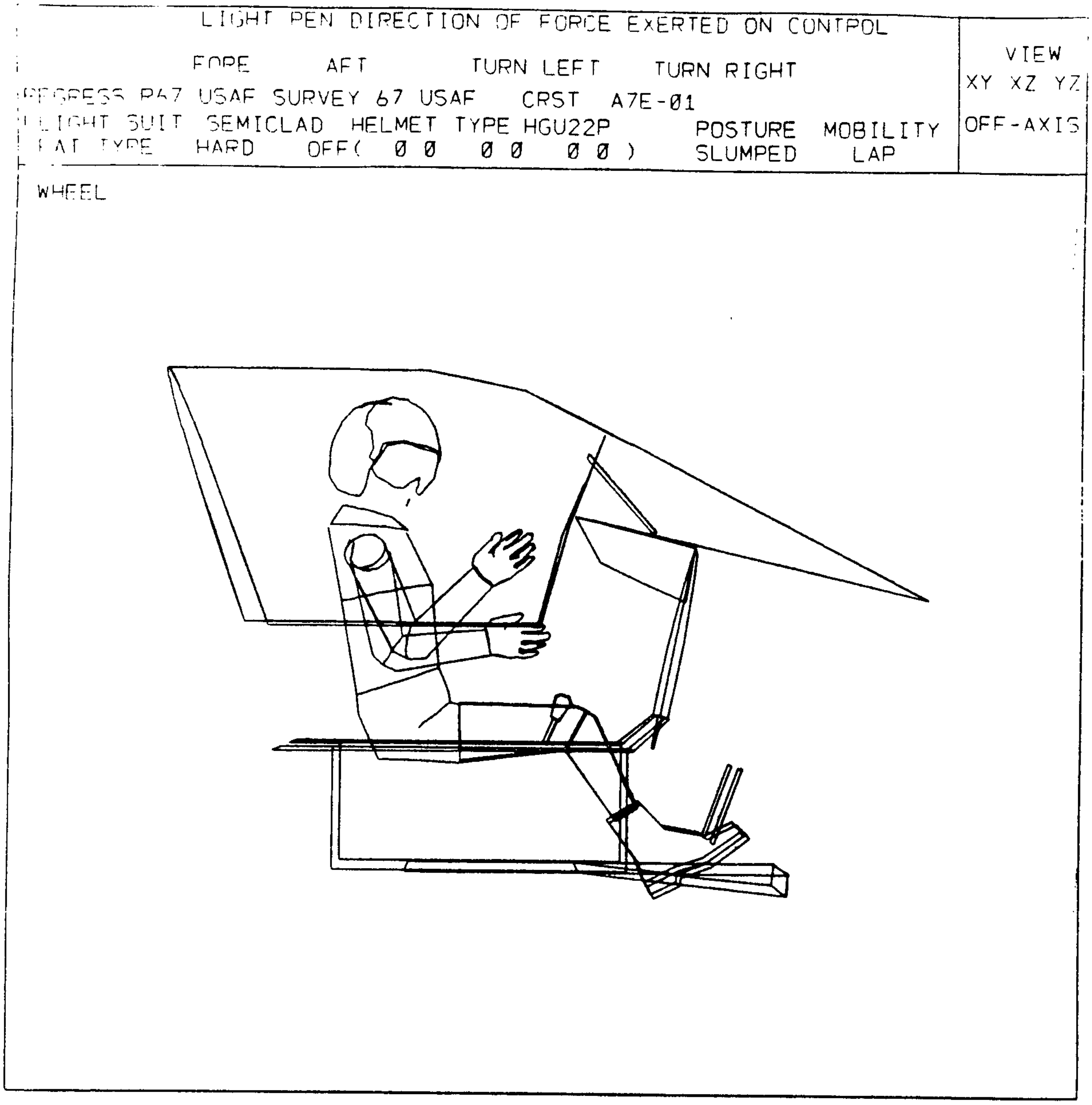



Figure 60. Light-Pen Direction of Force Exerted on Control.

YES TO CONTINUE" with the options "YES" or "NO" (see Figure 55). Selecting "YES" returns to that point of the program where the control was selected, but keeps the same reach point. Selecting "NO" displays the message "DO YOU WANT TO RESET POSTURE" as at the end of the REACH ANALYSIS. After selecting "YES" or "NO" the STRENGTH ANALYSIS terminates and returns to "DEPRESS PFK TO SELECT A FUNCTION". The user may continue with a new function, or reselect the STRENGTH ANALYSIS function to redefine the reach point.

### 2.2.18 REACH CURVE ANALYSIS Function (PFK20)

The REACH CURVE ANALYSIS function of the COMBIMAN allows the user to determine if a control panel lies inside, intersects with, or lies outside the crewmember's maximum arm-reach envelope. This evaluation is performed as a function of body size, clothing type, restraint type, and type of control. The function produces a reach enveloped in 3-D space and then computes the intersection of that reach envelope with a control panel in the crew station which the user selects with a light pen.

This function differs from the REACH ANALYSIS function (PFK11) in that the reach analysis is a reach to a point, with a graphical depiction of the crewmember performing the reach. The REACH CURVE ANALYSIS computes a reach envelope in 3-D space and displays the intersection of that envelope with some panel (plane surface) in the crew station. The COMBIMAN is not shown reaching to any single point, because there are many points along the reach envelope intersection. As an alternative to seeing the reach curve on the display, the user can have the reach curve and crew station plotted on an on-line or an off-line plotter.

The clothing types are a semiclad baseline condition plus common USAF flight clothing combinations: summer flying suit; summer flying suit with survival vest; winter flying suit; winter flying suit with survival vest; winter flying suit with vest, jacket, and flotation vest; and chemical defense ensemble.

There are three harness restraint conditions: LAP BELT ONLY, SHOULDER HARNESS UNLOCKED, and SHOULDER HARNESS LOCKED.

Four different types of hand controls are typically found in seated crew stations and the COMBIMAN can evaluate all four of these. The four types of reaches and controls are fingertip reach for operating pushbuttons, functional reach for

operating rotary knobs, grip center reach for operating vertical or horizontal handgrips.

Before performing a reach curve analysis, the user should reconsider how the anthropometry of the COMBIMAN was defined and if necessary, the user should redefine it. For evaluating reach to hand operated controls, the ARM LENGTH variable under the two variable method of body size definition in Paragraph 2.2.5 RETRIEVED ANTHROPOMETRY and Paragraph 2.2.13 INPUT TWO INDEPENDENT VARIABLES should be used.

To use the REACH CURVE ANALYSIS function, the user must then tell the computer what clothing type to use, what type of harness restraint is present, which limb is performing the reach, what type of grip to use (corresponding to the type of control being reached) and the location of the control. The user specifies the location of a control panel by light-penning some surface in the workplace or crew station.

The REACH CURVE ANALYSIS function is activated by depressing PFK20. The message "LIGHT-PEN CLOTHING TYPE" appears, with the options: SEMI-CLAD; SUMMER SUIT WITH VEST; SUMMER SUIT WITHOUT VEST; WINTER SUIT WITH VEST; WINTER SUIT WITHOUT VEST; WINTER SUIT WITH VEST, JACKET AND LIFE PRESERVER; and CHEMICAL DEFENSE GEAR (see Figure 61).

When clothing type has been selected the message "LIGHT-PEN GRIP TYPE" appears with the options: FINGER TIP, FUNCTIONAL, HORIZONTAL FULL, and VERTICAL FULL (see Figure 62).

When grip type has been selected the message "LIGHT-PEN RESTRAINT TYPE" appears, with options: LAP BELT ONLY, SHOULDER HARNESS UNLOCKED, AND SHOULDER HARNESS LOCKED, LAP, SHOULDER and ARM (see Figure 63).

When appropriate mobility has been selected the prompt message "DO YOU WANT TO CHANGE ANY? LIGHT-PEN YES OR NO" appears with a list of choices made (clothing type, grip type, and mobility type.

```
LIGHT-PEN CLOTHING TYPE                                                VIEW
                                                                   XY  XZ  YZ
EGRESS R67 USAF SURVEY 67 USAF    CRST  A7E-01
FLIGHT SUIT  SEMICLAD  HELMET TYPE HGU22P      POSTURE  MOBILITY   OFF-AXIS
SEAT TYPE   HARD    OFF(  -5 0    0 0    0 0)    PRGM'D     ARM
                                        RPY(    0 0,   -15 0,    15 0)
```

SEMICLAD

SUMMER SUIT

SUMMER SUIT W/VEST

WINTER SUIT

WINTER SUIT W/VEST

WINTER SUIT W/VEST  JACKET AND LIFE PRESERVER

CHEMICAL DEFENSE

Figure 61.  Select Clothing Type.

LIGHT-PEN GRIP TYPE

REGRESS R67 USAF SURVEY 67 USAF CRST A7E-Ø1
FLIGHT SUIT SEMICLAD HELMET TYPE HGU22P
SEAT TYPE HARD OFF( -5 Ø Ø Ø Ø Ø)

POSTURE PRGM'D

MOBILITY ARM

VIEW
XY XZ YZ
OFF-AXIS
RPY( Ø Ø, -15 Ø, 15 Ø)

FINGER TIP

FUNCTIONAL GRIP

HORIZONTAL FULL GRIP

VERTICAL FULL GRIP

Figure 62. Select Grip Type.

LIGHT-PEN RESTRAINT TYPE

VIEW

XY XZ YZ

OFF-AXIS

REGRESS R67 USAF SURVEY 67 USAF CRST A7E-Ø1

FLIGHT SUIT SEMICLAD HELMET TYPE HGU22P POSTURE MOBILITY

SEAT TYPE HARD OFF( -5 Ø Ø Ø Ø Ø) PRGM'D ARM

RPY( Ø Ø, -15 Ø, 15 Ø)

LAP BELT ONLY

SHOULDER HARNESS UNLOCKED

SHOULDER HARNESS LOCKED

Figure 63. Select Restraint Type.

YES selected - User will be prompted to "LIGHT-PEN TASK COMPONENT YOU WANT TO CHANGE" (see Figure 64). The selection of any one (clothing type, grip type, or mobility type) will result in the menu for that type reappearing with the message "LIGHT-PEN --- TYPE", with the appropriate options. He is then asked again if he would like to change any choices and the process is repeated until the user light-pens "NO".

NO selected - The prompt message "SELECT PANEL" appears. (Figure 65)

When the panel has been selected the message "WHICH ARM SHOULD BE USED?" appears with the options: RARM (right arm) or LARM (left arm). (Figure 66)

The user then selects the method of display in response to the prompt: "SELECT PRESENTATION MODE", with the three choices (Figure 67):

ON-SCREEN
OFF-LINE PLOT
ON-LINE PLOT

If on-screen is selected, the Reach Curve will appear superimposed on the crew station display. The user is then asked "DO YOU WANT TO ERASE CURVE? L.P. YES OR NO". The user then light-pens the appropriate response directly below the message line. If the user elects to not erase the curve, it becomes part of the crew station, and amenable to all the analysis functions that one can perform on any other crew station panel.

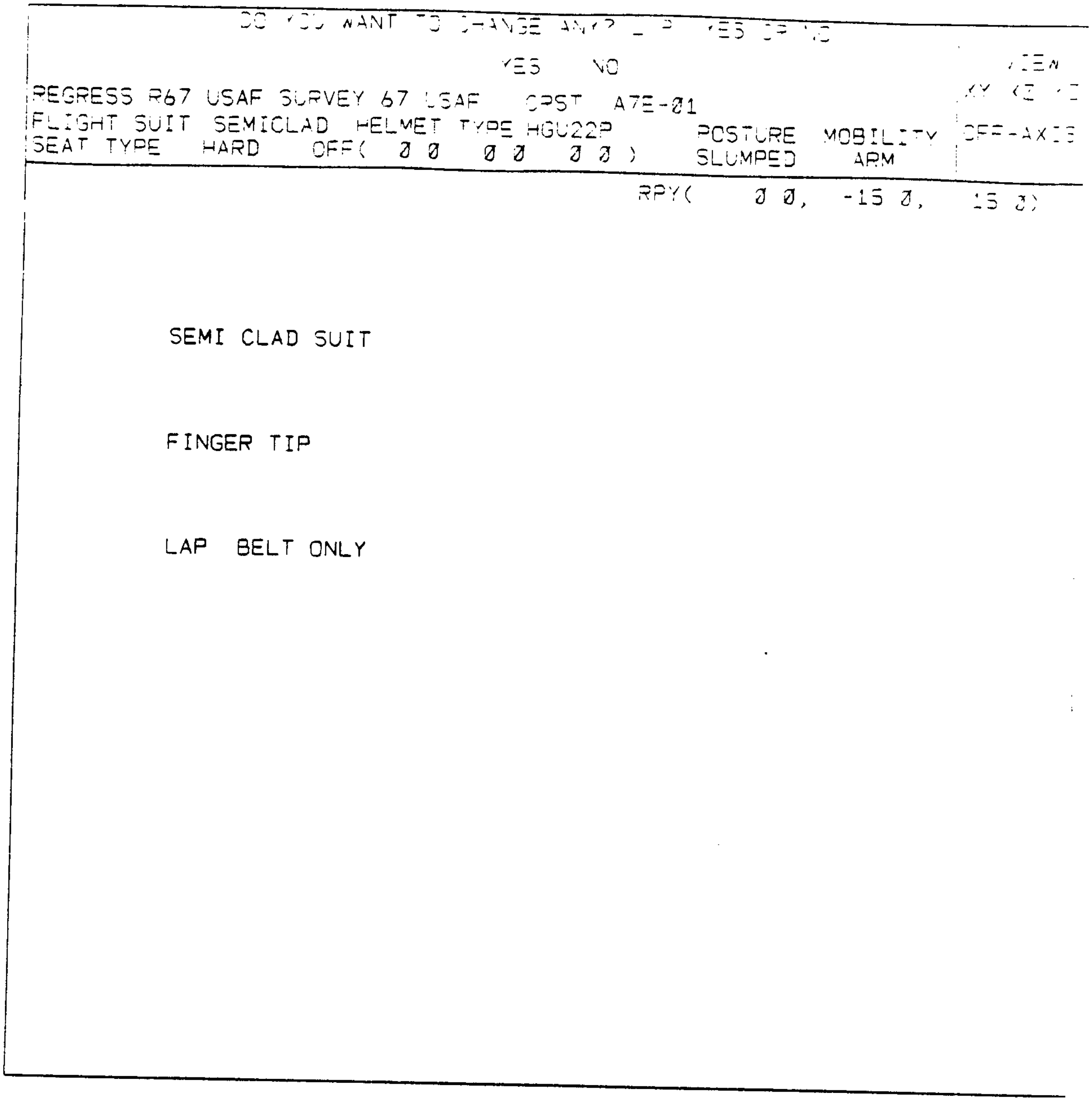



Figure 64. Light-Pen Task Component You Want To Change.

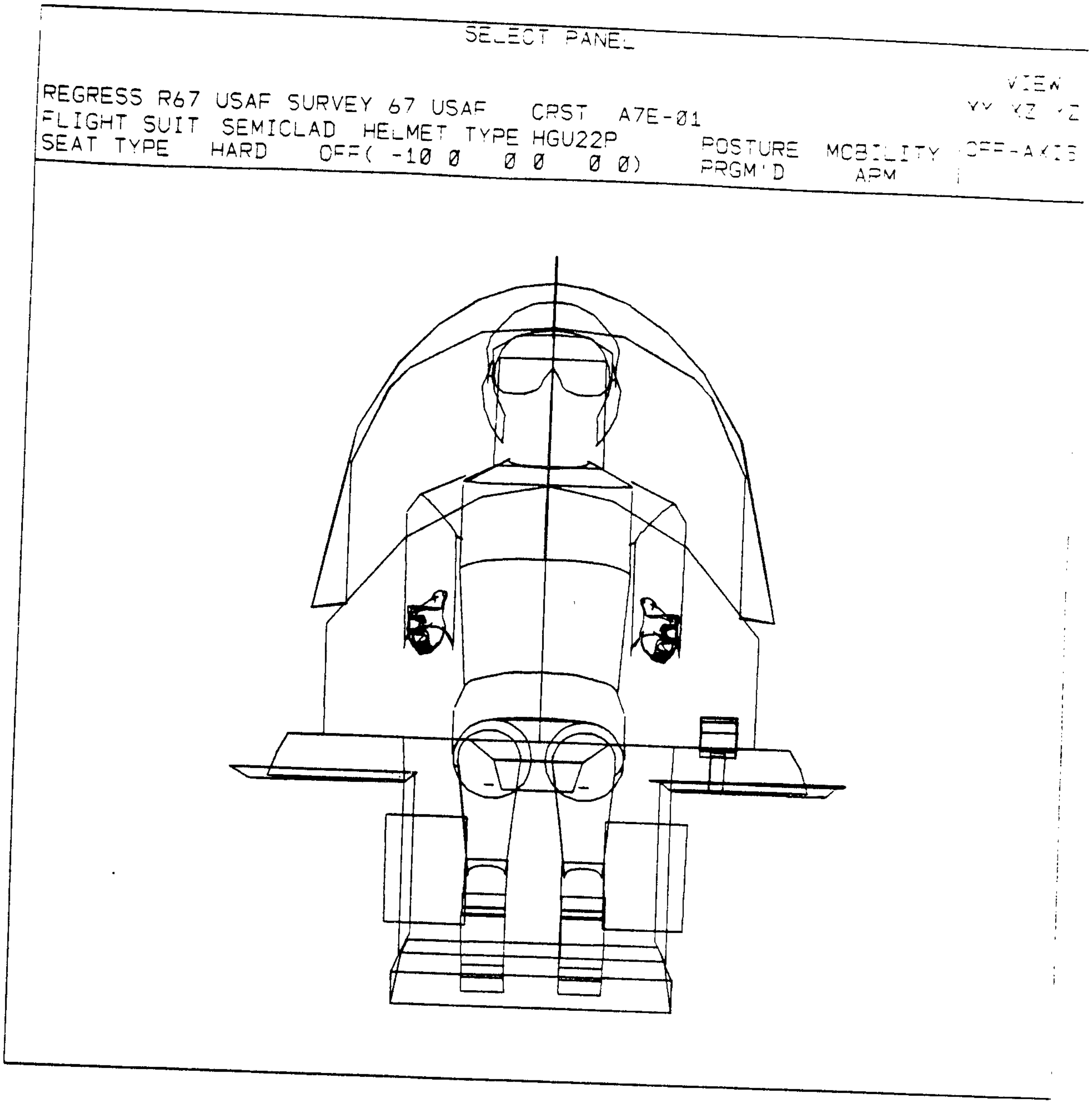



Figure 65. Select Panel.

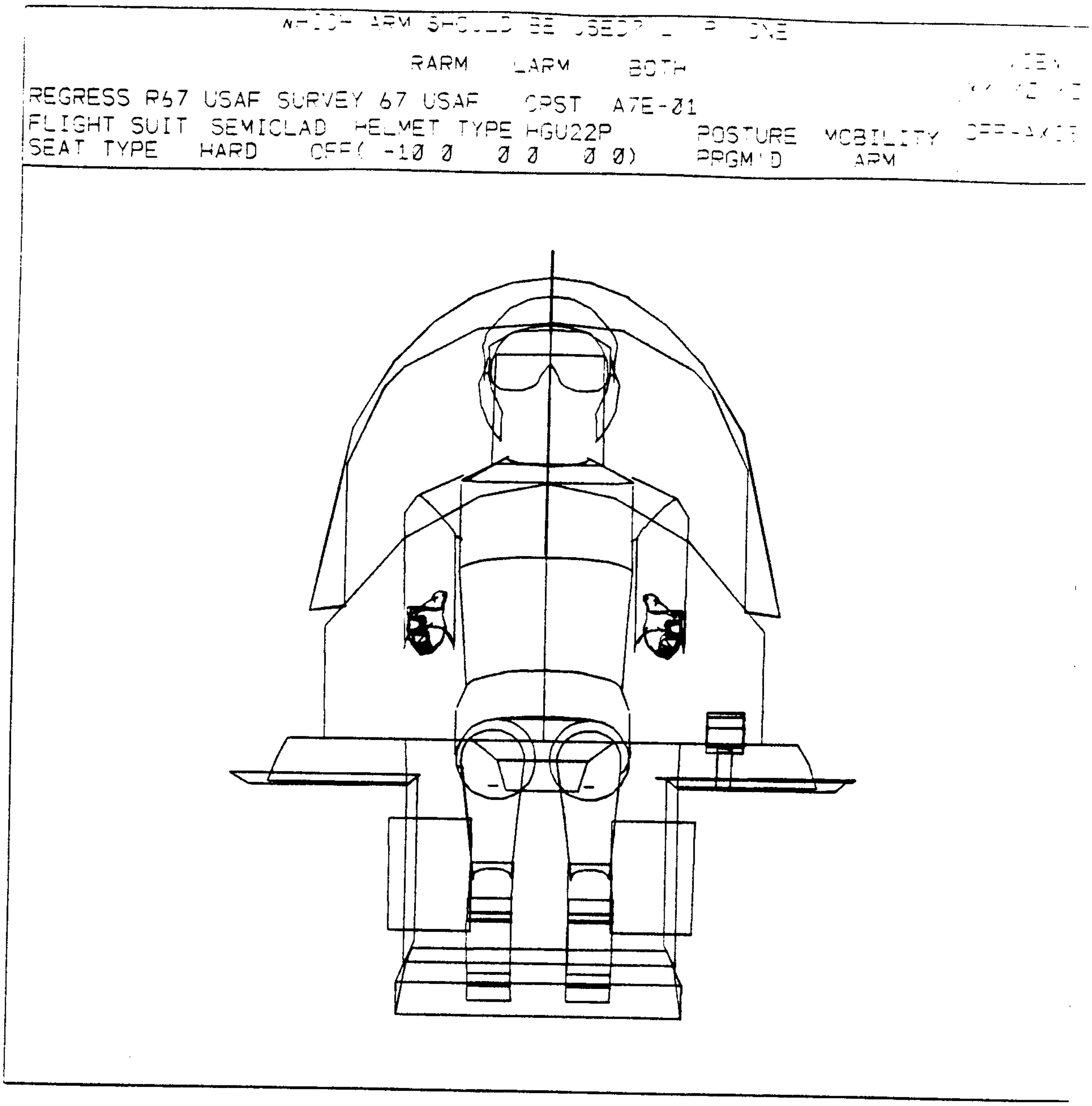



Figure 66. Which Arm Should Be Used?

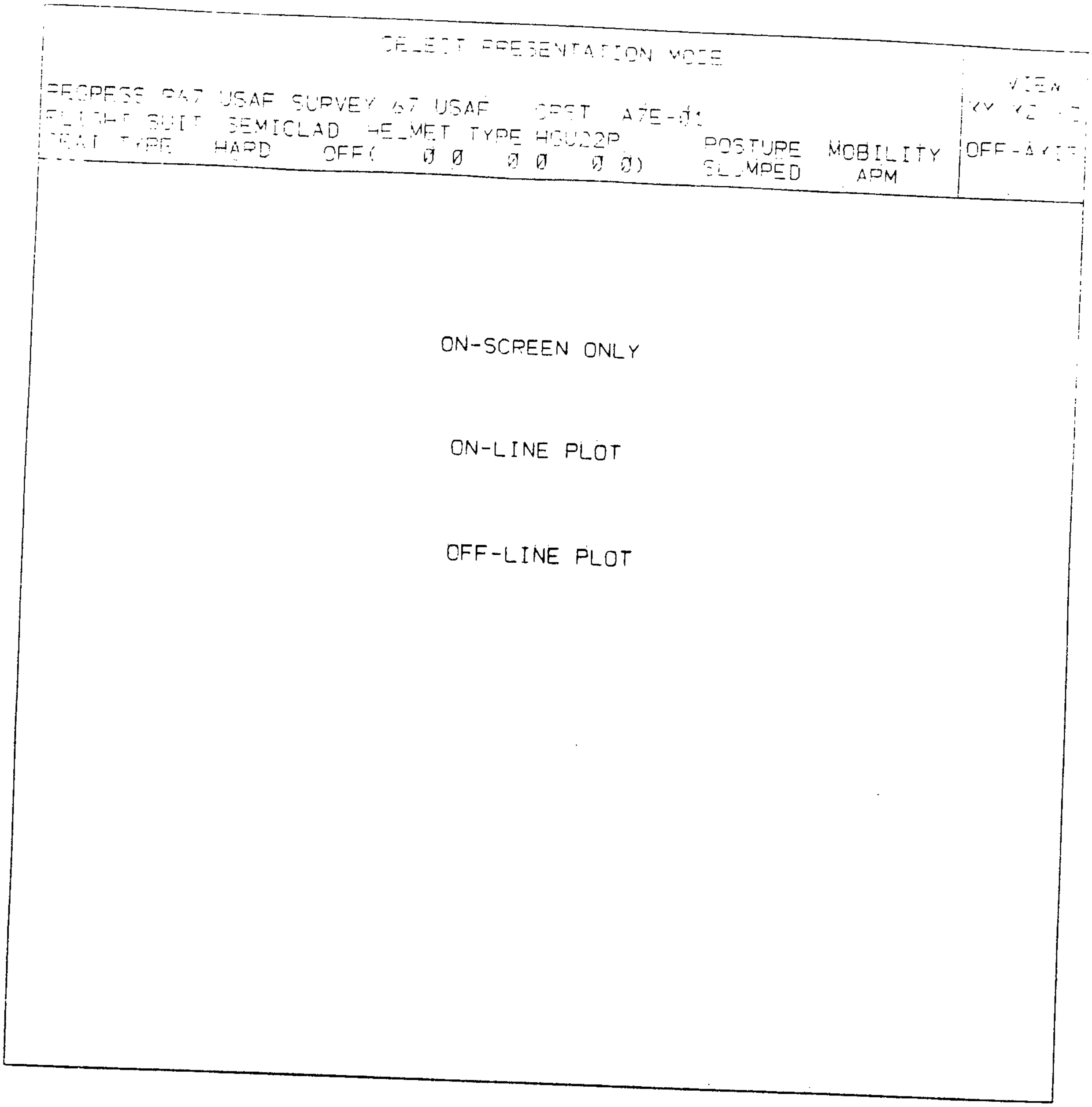



Figure 67. Select Presentation Mode.

If one of the plots is selected, the definition sequence for the on- or off-line plot function is begun. These functions are described in Paragraphs 2.2.8 and 2.2.9. Figure 68 shows an example of an on-line plot through the REACH CURVE ANALYSIS function.

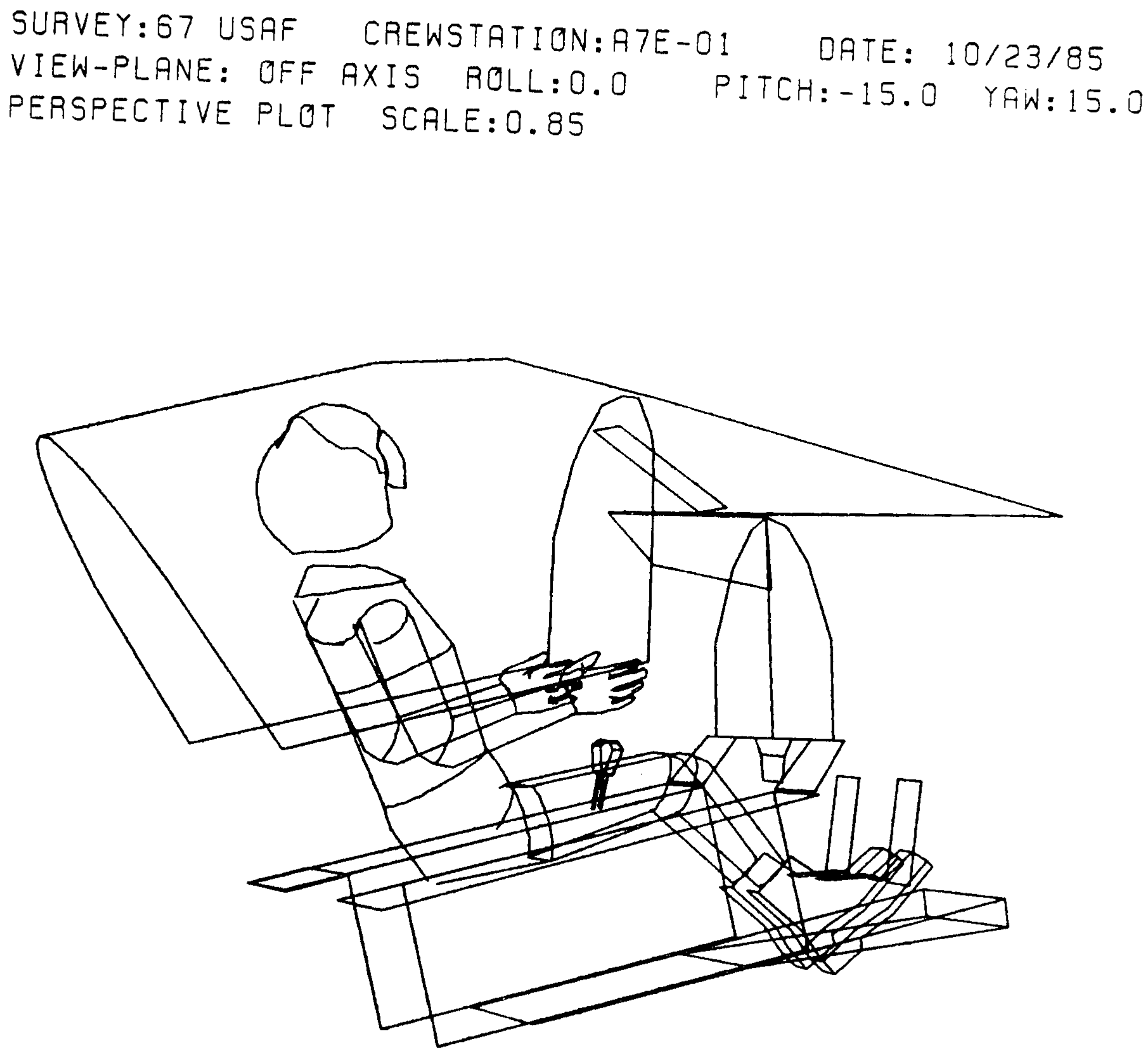



Figure 68. On-Line Plot of Reach Curve.

### 2.2.19 DISPLAY ANTHROPOMETRIC TABLE Function (PFK21)

The DISPLAY ANTHROPOMETRIC TABLE function allows the user to display the anthropometric variables and their values which were selected in creating the man-model. The function also displays the chosen or computed values of the twelve anthropometric surface dimensions. To select the DISPLAY ANTHROPOMETRIC TABLE function, the user depresses PFK21. When PFK21 is depressed the COMBIMAN display is temporarily removed from the screen and the message "DEPRESS CR TO CONTINUE" and the table of anthropometric dimensions appears on the screen.

Figure 69 is obtained when the user chose to input two independent variables 50 percentile sitting height (36.65 in) and 50 percentile weight (172.42 lbs) from the 67 USAF survey.

Figure 70 is obtained when the user chose to input twelve anthropometric variables in percentiles.

If the user defined the body size of the man-model in percentiles, those percentiles are displayed as in Figure 69 and 70. If absolute values were entered, percentile values are not displayed.

DEPRESS CR TO CONTINUE

| | | | | |
|---|---|---|---|---|
| REGRESS R67 USAF SURVEY 67 USAF | CRST A7E-01 | | | VIEW |
| FLIGHT SUIT SEMICLAD | HELMET TYPE HGU22P | | | XY XZ YZ |
| SEAT TYPE HARD | OFF( -10 0 0 0 0 0) | POSTURE PRGM'D | MOBILITY ARM | OFF-AXIS |

USER INPUT TWO INDEPENDENT VARIABLES

Z SCORE 1 65

INPUT VARIABLES ARE IN PERCENTILES

| | | |
|---|---|---|
| SITTING HEIGHT | 50 PCT | 36 65 IN |
| WEIGHT | 50 PCT | 172 42 LB |

COMPUTED ANTHROPOMETRIC DIMENSIONS

| NO | VARIABLE NAME | VALUE | UNIT |
|---|---|---|---|
| 1 | WEIGHT | 172 42 | LB |
| 2 | SITTING HEIGHT | 36 65 | IN |
| 3 | ACROMION HGT/SIT | 24 01 | IN |
| 4 | SHOULDR-ELB LGTH | 14 14 | IN |
| 5 | KNEE HGT/SITTING | 21 94 | IN |
| 6 | BUTTOCK-KNE LGTH | 23 77 | IN |
| 7 | BIACROMIAL BRDTH | 16 02 | IN |
| 8 | HIP BREADTH | 13 85 | IN |
| 9 | CHEST DEPTH | 9 62 | IN |
| 10 | FOOT LENGTH | 10 63 | IN |
| 11 | HAND LENGTH | 7 52 | IN |
| 12 | ELBOW-WRIST LGTH | 11 80 | IN |

Figure 69. DISPLAY ANTHROPOMETRIC TABLE Function. Input two variables.

DEPRESS CR TO CONTINUE

_

PEGRESS R67 USAF SURVEY 67 USAF CRST A7E-01
FLIGHT SUIT SEMICLAD HELMET TYPE HGU22P
SEAT TYPE HARD OFF( 0 0 0 0 0 0 )

POSTURE SLUMPED
MOBILITY ARM

VIEW
XY XZ YZ
OFF-AXIS

INPUT TWELVE DEPENDENT VARIABLES
INPUT VARIABLES ARE IN PERCENTILES

| NO | VARIABLE NAME | UNIT | INPUT VALUE | COMPUTED VALUE | UNIT |
|---|---|---|---|---|---|
| 1 | WEIGHT | LB | 40 PCT | 167 08 | LB |
| 2 | SITTING HEIGHT | IN | 35 PCT | 36 17 | IN |
| 3 | ACROMION HGT/SIT | IN | 35 PCT | 23 58 | IN |
| 4 | SHOULDR-ELB LGTH | IN | 35 PCT | 13 88 | IN |
| 5 | KNEE HGT/SITTING | IN | 35 PCT | 21.57 | IN |
| 6 | BUTTOCK-KNE LGTH | IN | 35 PCT | 23 36 | IN |
| 7 | BIACROMIAL BRDTH | IN | 40 PCT | 15 86 | IN |
| 8 | HIP BREADTH | IN | 35 PCT | 13 59 | IN |
| 9 | CHEST DEPTH | IN | 40 PCT | 9 46 | IN |
| 10 | FOOT LENGTH | IN | 45 PCT | 10 57 | IN |
| 11 | HAND LENGTH | IN | 45 PCT | 7 47 | IN |
| 12 | ELBOW-WRIST LGTH | IN | 45 PCT | 11 73 | IN |

Figure 70. DISPLAY ANTHROPOMETRIC TABLE Function.
Input 12 variables.

### 2.2.20 CHANGE PERSPECTIVE Function (PFK22)

The CHANGE PERSPECTIVE function allows the user to change the point of view and/or the effective viewing distance between the displayed man-model and the crew station. This function is useful in enhancing the perspective and therefore the three-dimensional character of the displayed image.

To activate the CHANGE PERSPECTIVE function, first depress PFK22. The program displays the message "VIEW ADJUST" and temporarily redefines PFKs 1, 2, 3, 4, 5, 6, 9, and 10 as shown in Figure 71. If the user depresses PFK9, the message "LIGHT-PEN NEW CENTER POINT" is displayed. The user may respond by light-penning any desired point in the display. Now the program displays the man-model and the crew station as if looking along the point light-penned. The perspective of the display is initialized as if the viewing distance is 30 feet away from the screen. This distance may be increased in increments of 10 feet by repeatedly depressing PFK1, or decreased (closer to the screen) in increments of 10 feet by depressing PFK3. This distance increment may be redefined by selecting PFK4, for a 1 foot increment; PFK5, for a 10 feet increment; or PFK6, for a 100 feet increment. However, the lower and upper limits for the effective viewing distance are 10 feet and 1,000 feet respectively.

PFK 9 must be depressed to select another view point.

PFK2 must be depressed to terminate the CHANGE PERSPECTIVE function and to return to the main program, resetting all PFKs to the original definition.

PFK10 terminates the CHANGE PERSPECTIVE function, resetting the display and PFK definitions to their original positions.

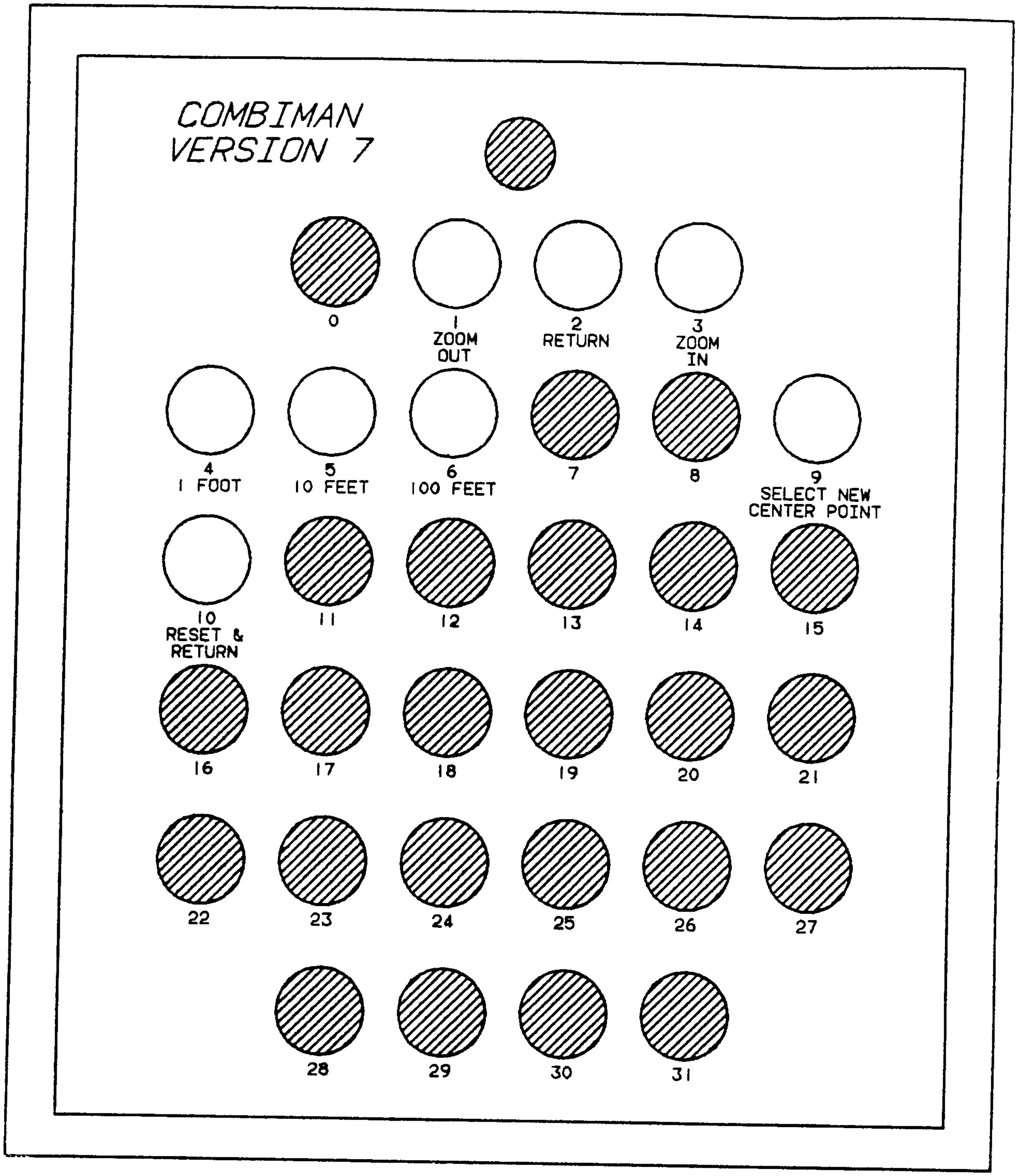



Figure 71. PFK's for Change Perspective Function. Shaded keys are not used or illuminated.

### 2.2.21 RESET SLUMPED POSTURE Function (PFK23)

The RESET SLUMPED POSTURE function resets the transformation angles of the man-model so that it assumes a slumped posture, as shown in Figure 72. The "slumped posture" is a posture for sitting erect in a seat with 13 degree back angle and a six degree seat pan angle. If other postures are desired, the skeletal-link angles have to be changed by the method specified in Paragraph 2.2.14, the DISPLAY TABLE function and the RESET PROGRAMMED POSTURE function as described in Paragraph 2.2.22. This function is commonly used to get back to a starting posture after a reach analysis or a modification of joint angles as described in Paragraph 2.2.14. The SLUMPED POSTURE is also the default posture of the man-model.

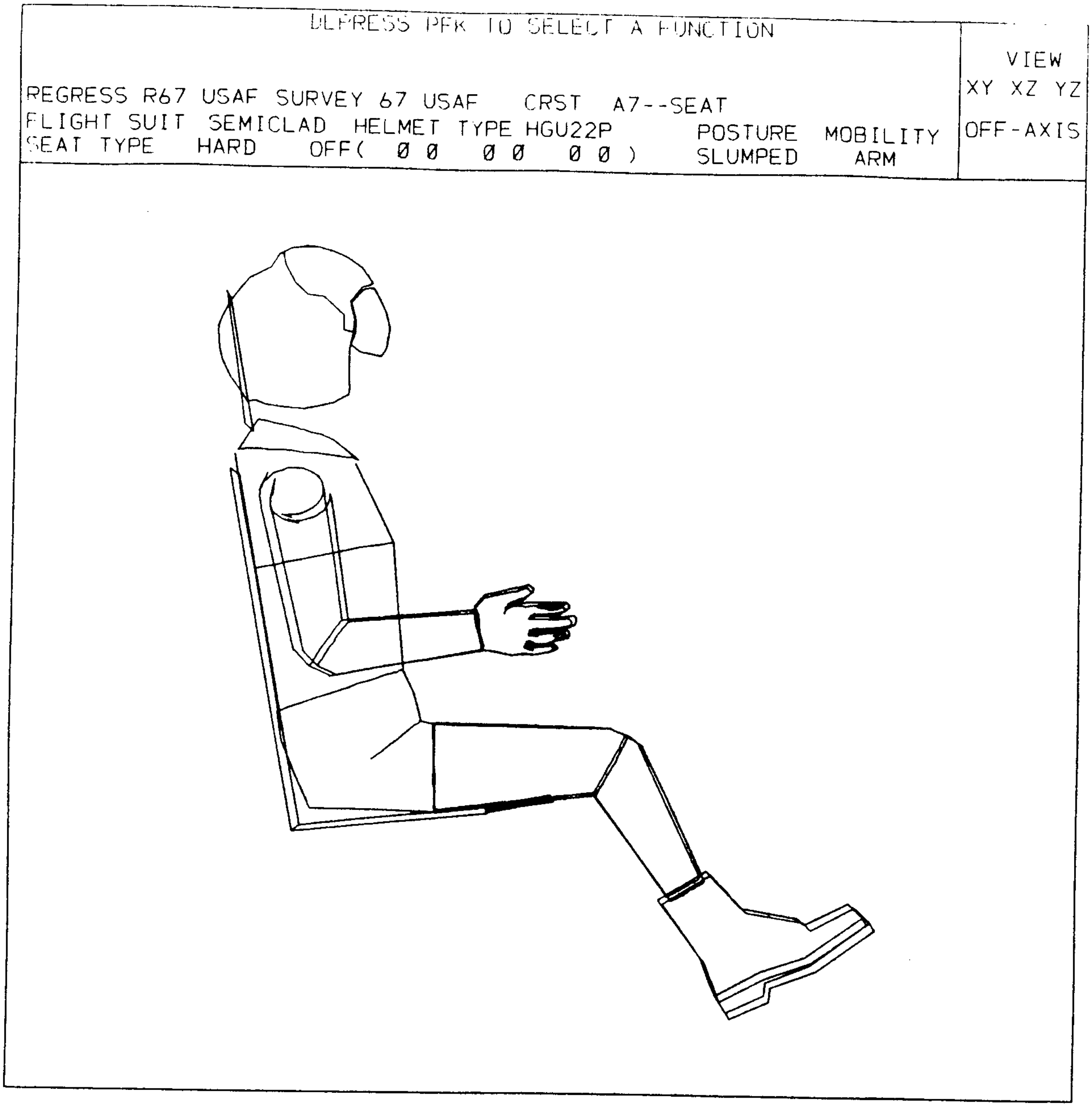



Figure 72. RESET SLUMPED POSTURE Function.

### 2.2.22 RESET ERECT POSTURE Function (PFK24)

The RESET ERECT POSTURE function resets the transformation angles of the man-model so that it assumes the standard erect posture as shown in Figure 73.

This is the standard posture for performing anthropometric measures on a seated subject, and is used to confirm dimensions of the man-model.

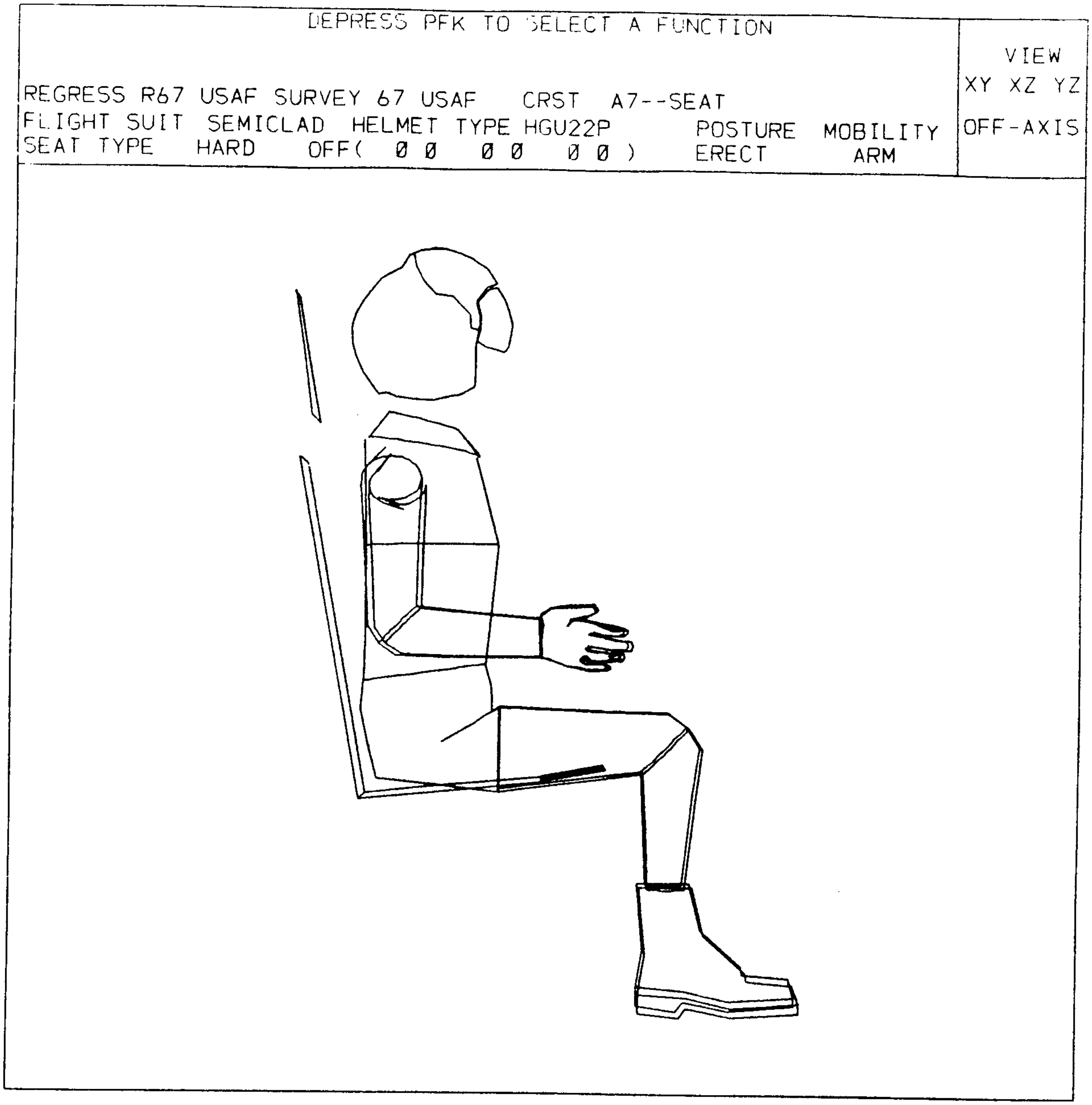



Figure 73. RESET ERECT POSTURE Function.

### 2.2.23 RESET PROGRAMMED POSTURE Function (PFK25)

The RESET PROGRAMMED POSTURE function resets the transformation angles of the man-model so that it assumes the "Programmed Posture". The "Programmed Posture" is any posture the user desires, which can be achieved by modifying the transformation angles using the DISPLAY TABLE function (see Paragraph 2.2.14). After all changes are made, the new posture of the man-model can be redisplayed at any time by depressing PFK25 (see Figure 74).

When the program CBM07 is initialized, the angles for the SLUMPED POSTURE are automatically entered into this PROGRAMMED POSTURE storage area, so initially pressing the PFK25 merely recalls the SLUMPED POSTURE. However, anytime the user changes any one or more angles in the link system Display Table, the changed angles are automatically entered into the PROGRAMMED POSTURE storage area. This function may be thought of as a "redisplay" of the last change to the Display Table (see Paragraph 2.2.14).

The angles changed by this function are not stored permanently. Therefore, everytime a new man-model is defined the angles for PROGRAMMED POSTURE must be redefined.

This function may be used to define a working posture to the user's own specification. Normally, a pilot sits with upper-back and head well forward, causing the eye position to be lowered. Since one posture will not serve all applications, this function allows the user to define and recall any posture.

To get the programmed position shown in Figure 74, the erect posture is chosen and the following changes are made using DISPLAY TABLE function (PFK14):

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| RUPRLEG | PH1 | from | 90.0 | to | 0.0 | degrees |
| RLWRLEG | THETA | from | 90.0 | to | 0.0 | degrees |
| LUPRLEG | PH1 | from | -90.0 | to | 0.0 | degrees |
| LLWRLEG | THETA | from | 90.0 | to | 0.0 | degrees |

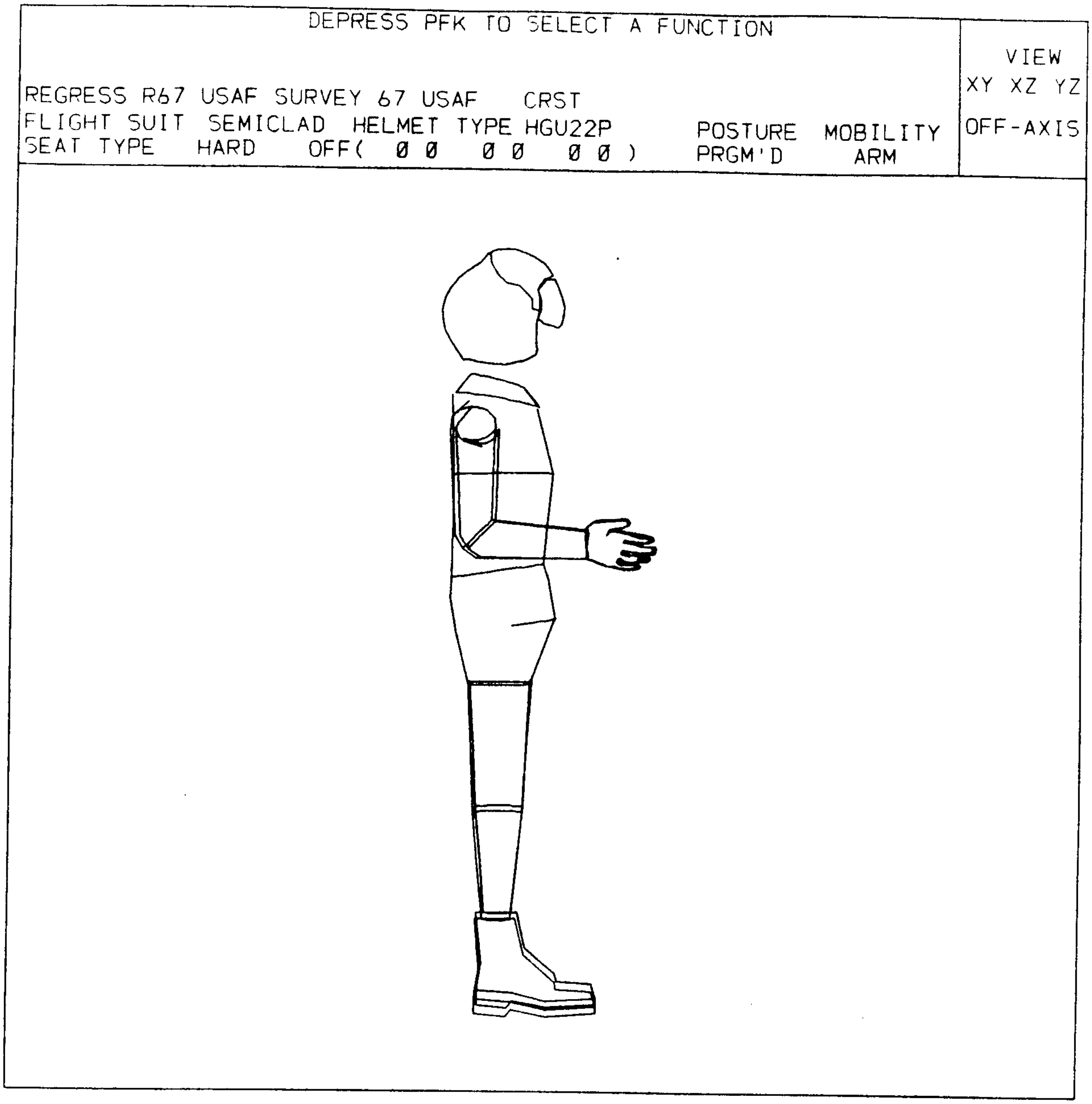



Figure 74. RESET PROGRAMMED POSTURE Function.

The following are a few examples of other useful programmed postures.

1. To turn the COMBIMAN head to the left/right, increase/decrease the value of PSI of NECK-MHD link.

2. To rotate the COMBIMAN head upwards/downwards, decrease/increase the value of THETA of NECK-MHD.

3. To lower/raise the forearms, decrease/increase the values of THETA of both RLWARM and LLWRARM.

4. To raise/lower the upper arms out from the side, increase/decrease the value of THETA of both RUPARM and LUPARM.

5. To raise/lower the upper arms out in front of COMBIMAN, increase/decrease the value of PHI of RUPARM and decrease/increase the value of PHI of LUPARM.

### 2.2.24 INCREMENT ROLL, PITCH, AND YAW ANGLE Function (PFK26)

The INCREMENT ROLL, PITCH, AND YAW ANGLE function allows the user to reorient the displayed crewstation on th CRT by entering a set of roll, pitch and yaw angle increments by which the man-model and crew station are rotated; and a maximum number of iterations desired before the display resets to roll, pitch and yaw angle values of 0.0 degrees. It is similar to a series of "CHANGE VIEW" function calls described in Paragraph 2.2.1.

This feature allows the user to rapidly rotate the model through a series of discrete steps. The user may pause after any step to make a plot, or select other functions. The preprogrammed example uses six discrete rotational increments of 0 degrees, -15 degrees, and +15 degrees for the roll, pitch, and yaw angles. The user may redefine the number of increments or the roll, pitch, and yaw increments in the following manner.

First set state switch 10 "ON" as described in Paragraph 2.2.28. Then depress PFK26 and respond to message "ENTER ROLL ANGLE" by entering the ROLL increment angle in degrees through the ANKB. Respond to subsequent messages to enter PITCH and YAW angles the same way. The message "ENTER MAX. NO. ITERATIONS" then appears in the Prompting Area of the CRT. The user must then type the number of keystrokes of PFK26 the program should take before resetting the display to the XZ (side) view as shown in Figure 11.

The directions of rotation are as follows:

| | |
|---|---|
| ROLL (Rotation about X-axis): | negative=left<br>positive=right |
| PITCH (Rotation about Y-axis): | negative=nose up<br>positive= nose down |
| YAW (Rotation about Z-axis): | negative=right<br>positive=left |

2.2.25 SEAT ADJUST Function (PFK27)

The SEAT ADJUST function allows the user to off-set the man-model and his seat, if any, with respect to the displayed crew station. This function cannot be activated unless a crew station is displayed on the CRT screen. A seat may or may not be preset at the user's option. The default values of the coordinates for this function are X=0, Y=0, and Z=0, which is the Neutral Seat Reference Point. After depressing PFK27, the user is prompted to enter the X coordinate off-set. The value in inches is typed using the ANKB and is entered by depressing the CR key as shown in Figure 75. If the default value (0 inch) is to be retained, simply depress the CR key. The program then prompts the user to enter the Y and Z coordinates in that order. The user must enter them the same way the X coordinate is entered. The new coordinates will be displayed in the Informational Area. Since the seat may be "adjusted" in three dimensions, this provides a method for placing the man-model (and seat) in different stations in a multioperator crew station.

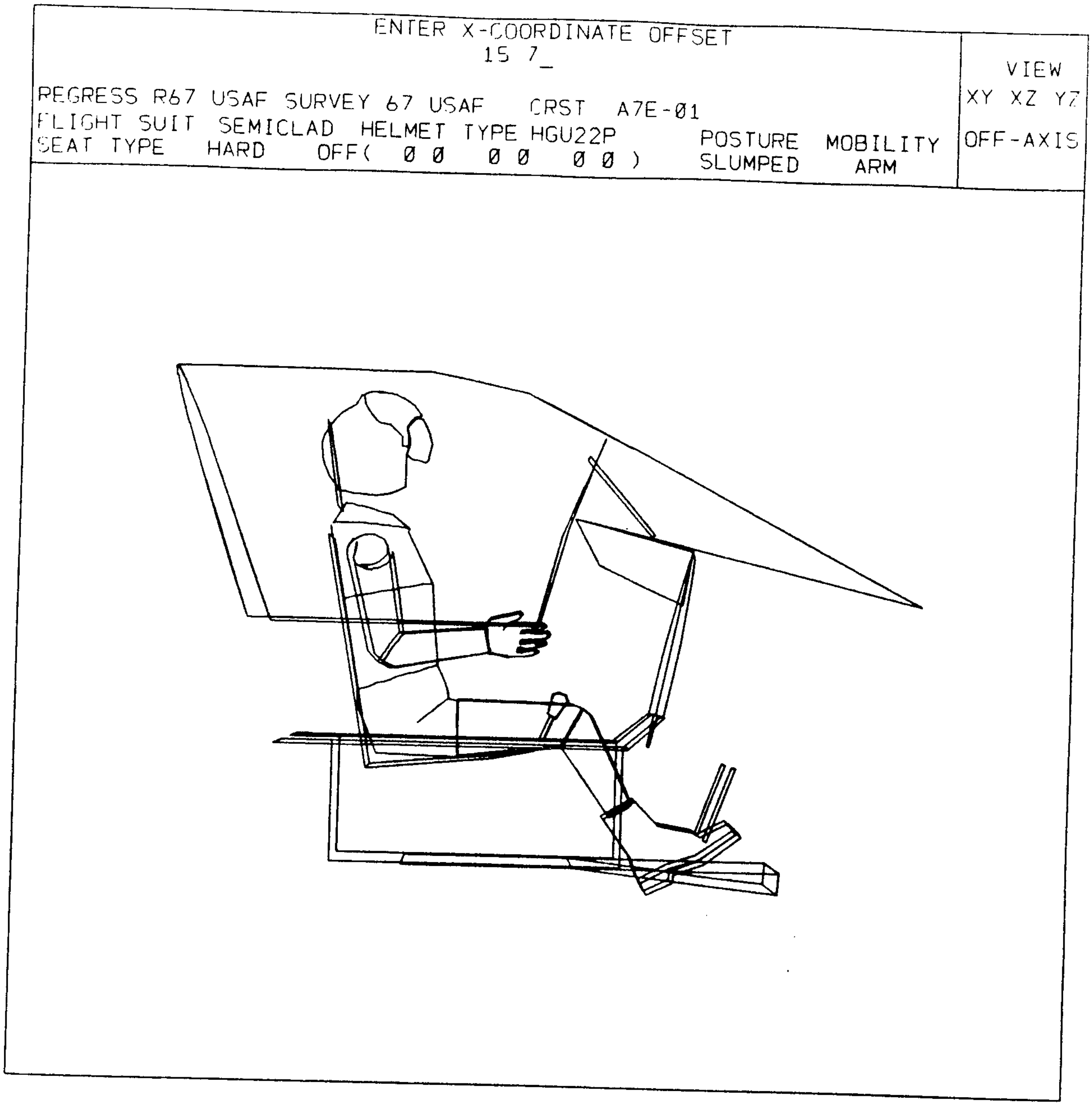



Figure 75. SEAT ADJUST Function Enter X Coordinate Offset in Inches.

### 2.2.26 ZOOM Function (PFK28)

The ZOOM function allows the user to "Zoom-in" on a user defined portion of the COMBIMAN Display Area. To activate the ZOOM function depress PFK28. The message "DEFINE ZOOM WINDOW" momentarily appears in the Prompting Area of the CRT. Next, a matrix of dots at 0.5 inch intervals cover the COMBIMAN Display Area and a message "LIGHT-PEN LOWER LEFT CORNER" appears in the Prompting Area of the CRT.

Light-pen a dot to designate the lower left hand corner of the proposed zoom window. The program displays the limiting left and bottom lines of the window, and erases all dots below the horizontal line and left of the vertical line. Then the message "LIGHT-PEN UPPER RIGHT CORNER" appears in the Prompting Area as shown in Figure 76. The user may depress the CR key to register the upper right corner of the Display Area as the upper right corner of the zoom window. Now all the dots are removed and the completed zoom window boundaries are displayed. The display is then regenerated with the information within the defined zoom window filling the entire Display Area of the CRT as shown in Figure 77.

The message "DO YOU WANT TO END ZOOM? ENTER Y/N" then appears in the Prompting Are of the CRT. The user now has the option to zoom-in further on the current display by answering "N" or "NO" using the ANKB, or to end the ZOOM function by depressing the CR key. Note that "Y" or "YES" is the default for the "DO YOU WANT TO END ZOOM? ENTER Y/N" message. When the ZOOM function is ended, control returns to the main routine, however, the display will remain in the zoom state until execution of another function (such as CHANGE VIEW) causes regeneration of the display. A second method to return the display to the normal scaling and perspective at the termination of the ZOOM function is to set state switch 21 "ON" prior to depressing PFK28 to execute the ZOOM function.

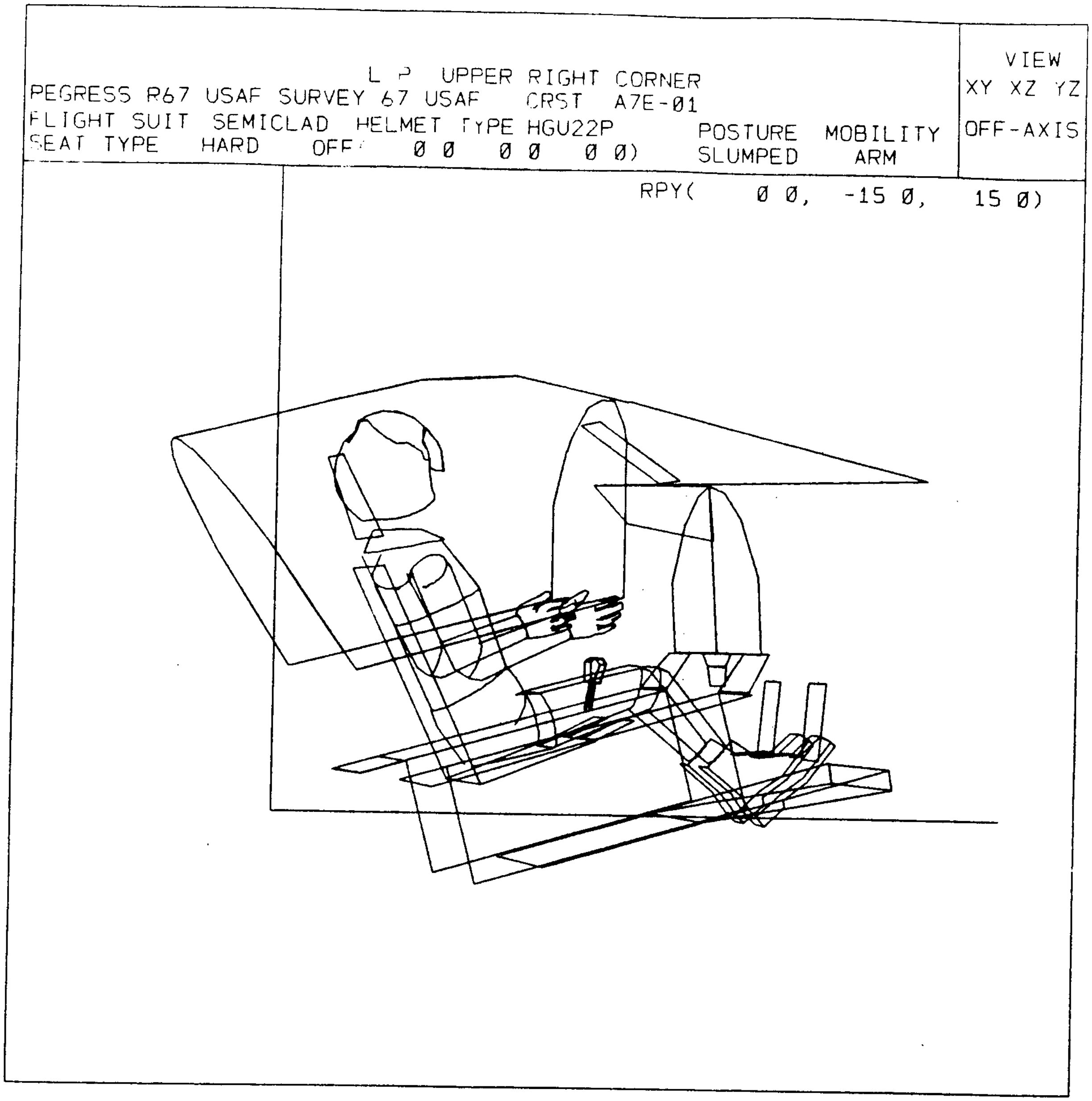



Figure 76. Define ZOOM Window.

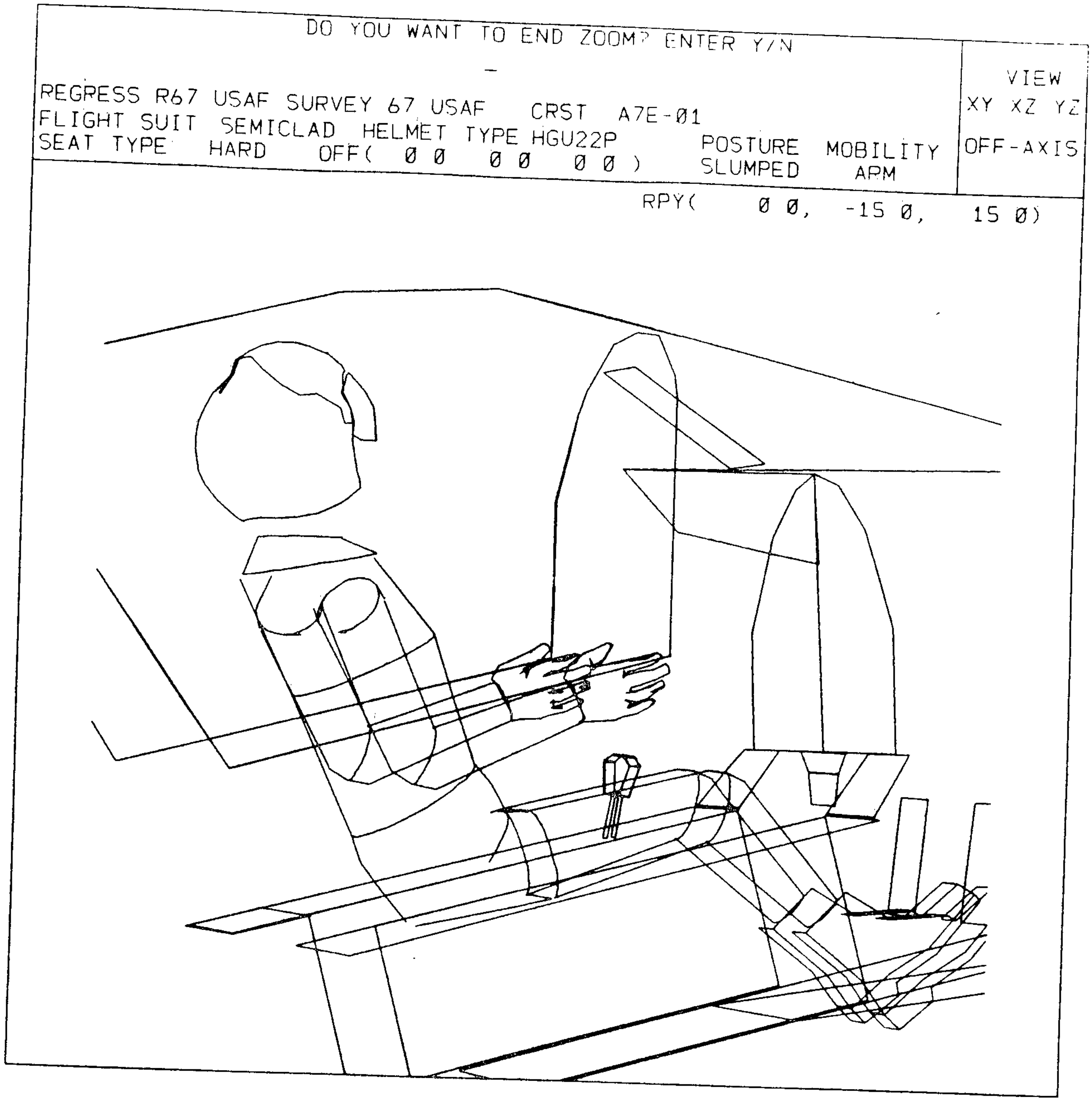



Figure 77. The "ZOOMED" Display.

When the user answers "N" or "NO" to the prompting message, "DO YOU WANT TO END ZOOM? ENTER Y/N" the message "DEFINE ZOOM WINDOW" is displayed. The user then defines new zoom window on the already zoomed-in display. The ZOOM process continues until the user depresses the CR key to define the lower left corner of the zoom window, or a response other than "N" or "NO" is entered upon completion of a requested zoom.

2.2.27 STATE SWITCH Function (PFK29)

The STATE SWITCH function allows the user to select many variations in the operation of the COMBIMAN program. When the COMBIMAN program is initiated, all STATE SWITCHES are "OFF".

When the STATE SWITCH function is selected by depressing PFK29, the COMBIMAN display disappears and the list of available switches and the meanings of their states when set "ON" and "OFF" and the message "LIGHT-PEN SWITCH NUMBER" appears on the CRT as shown in Figure 78. After the user light-pens the switch number to be changed all others are erased from the screen. Now the user is prompted to light-pen "ON" or "OFF". When "ON" or "OFF" is light-penned, CBM07 invokes the corresponding state as detailed in Figure 79.

State Switch 2: Crewstation Data

ON - Produces a printout of the 3-D coordinate data of the crew station geometry.

State Switch 3: Man-Model Links

ON - All 35 internal links of the man-model defined in Paragraph 2.2.14 (Table 3) are displayed.

OFF - Only 5 internal links of the man-model are displayed. The links are NECK, NECK-MHD, MHD-MEYE, MEYE-REY, and MEYE-LEY.

State Switch 4: Nonperspective View

ON - Displays nonperspective man-model and crew station as shown in Figure 33. (See Paragraph 2.2.8 for definition of perspective and nonperspective views.)

OFF - Displays perspective man-model and crew station as shown in Figure 3.

LIGHT-PEN STATE SWITCH NUMBER

| SWITCH # | ON | OFF |
|---|---|---|
| 2 | PRINT CREWSTATION DATA | SUPPRESS CREWSTATION DATA |
| 3 | DISPLAY ALL LINKS OF MODEL | ONLY NECK, HEAD & EYE LINKS |
| 4 | DISPLAY NON-PERSPECTIVE MODEL | DISPLAY PERSPECTIVE MODEL |
| 5 | SUPPRESS ENFLESHMENT DISPLAY | DISPLAY ENFLESHED MAN-MODEL |
| 6 | PRINT INTERNAL LINKS | SUPPRESS INTERNAL LINKS |
| 1Ø | RESET ITERATIONS FOR RPY | ASSUME ITERATION VALUE 6 |
| 13 | SUPPRESS MAN-MODEL DISPLAY | DISPLAY MODEL & CREWSTATION |
| 16 | CHANGE ENFLESHMENT DENSITY | ASSUME ENFLESHMENT DENSITY Ø |
| 19 | CHANGE VISIBILITY PLOT SCALE | ASSUME SCALE FACTOR 1.Ø |
| 2Ø | PRINT VISIBILITY DATA POINTS | SUPPRESS VISIBILITY DATA |
| 21 | ZOOMED IMAGE NOT RETAINED | RETAIN ZOOMED IMAGE |
| 22 | INPUT ANTH DATA FROM CARD | NO ANTH DATA FROM CARD |
| 23 | CHOOSE NEW CREW DATA BASE | CHOOSE OLD CREW DATA BASE |
| 24 | DISPLAY AIRCRAFT COORDINATES | DISPLAY COMBIMAN COORDINATES |
| 72 | PRINT LINK MATRICES | SUPPRESS LINK MATRICES |

Figure 78. Available State Switches and Functions.

LIGHT-PEN ON/OFF

| | ON | OFF |
|---|---|---|
| 4 | DISPLAY NON-PERSPECTIVE MODEL | DISPLAY PERSPECTIVE MODEL |

Figure 79. State Switch 4 Chosen. User light pens ON/OFF.

State Switch 5: Enfleshment

ON - Displays no enfleshment. The man-model will have all 35 links and will look like a stick figure shown in Figure 1.

OFF - Displays man-model with profile enfleshment.

State Switch 6: Print Out Man-Model Data

ON - Prints the name, length vectors, and information about the enfleshment ellipsoids for all the links (see Figure 80).

State Switch 10: Change RPY Increment

ON - For the Increment Roll, Pitch, and Yaw angle function (PFK26), it allows the user to enter increment angles for Roll, Pitch, and Yaw and also the number of PFK26 keystrokes desired before returning the display to the XZ (side view) plane. See Paragraph 2.2.23 for details.

OFF - Assumes the default increment angle values of
Roll = 0.0°
Pitch = 15.0°, and
Yaw = 15.0°, and
Keystrokes = 6.

State Switch 13: Suppress Man-Model

ON - Suppresses man-model display if crew station is present.

OFF - Displays both man-model and crew station.

State Switch 16: Enfleshment Density

ON - Allows the user to input a number to increase the enfleshment density (the number of dots representing the enfleshment ellipsoids) of the man-model. When the message "ENTER ENFLESHMENT DENSITY CODE" is displayed the user enters:

(1) Any number from one to four for increased enfleshment point density,

(2) Zero for normal enfleshment density, and

COMBIMAN LINK DATA

REFERENCED SURVEY OF REGRESSION EQUATIONS IS R67 USAF
REFERENCED SURVEY OF ANTHROPOMETRIC DIMENSIONS IS 67 USAF

| NO. | LINK NAME | LENGTH | REF. ANTH. DIM. | A-LENGTH | A-OFFSET | B-LENGTH | B-OFFSET | C-LENGTH | C-OFFSET |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SRP | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1 | SRP-MHIP | 5.75 | BUTTOCK-KNE LGTH | 4.582 | -0.960 | 7.413 | 0.0 | 4.582 | 0.653 |
| 2 | MHIP-L34 | 5.18 | ACROMION HGT/SIT | 4.367 | 0.713 | 6.067 | 0.0 | 4.367 | 0.139 |
| 3 | CHEST | 9.46 | SITTING HEIGHT | 4.808 | 2.027 | 6.431 | 0.0 | 4.808 | -0.394 |
| 4 | T89-T1 | 7.48 | SITTING HEIGHT | 3.612 | 0.467 | 8.008 | 0.0 | 3.612 | -2.226 |
| 5 | NECK | 5.21 | SITTING HEIGHT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 6 | NECK-MHD | 1.40 | SITTING HEIGHT | 3.884 | 0.0 | 3.042 | 0.0 | 4.471 | 0.340 |
| 7 | MHD-MEYE | 3.33 | SITTING HEIGHT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 8 | MEYE-REY | 1.25 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 9 | MEYE-LEY | 1.25 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 10 | T1-MSS | 3.22 | SITTING HEIGHT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11 | MSS-RSS | 1.00 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12 | RSS-RSLD | 8.25 | BIACROMIAL BRDTH | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13 | RSLDR | 0.0 | | 2.305 | 0.0 | 2.304 | 0.0 | 2.074 | -0.300 |
| 14 | RUPARM | 10.93 | SHOULDR-ELB LGTH | 1.729 | 0.553 | 1.729 | 0.0 | 1.729 | -0.838 |
| 15 | RLWARM | 10.56 | ELBOW-WRIST LGTH | 1.100 | 0.0 | 1.100 | 0.0 | 1.100 | 0.0 |
| 16 | RGRIP | 2.00 | HAND LENGTH | 2.004 | 0.0 | 0.540 | 0.0 | 3.759 | 1.759 |
| 17 | RFNRCH | 4.69 | HAND LENGTH | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 18 | RFNGRTIP | 7.52 | HAND LENGTH | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 19 | MSS-LSS | 1.00 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 20 | LSS-LSLD | 8.25 | BIACROMIAL BRDTH | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 21 | LSLDR | 0.0 | | 2.305 | 0.0 | 2.304 | 0.0 | 2.074 | -0.300 |
| 22 | LUPARM | 10.93 | SHOULDR-ELB LGTH | 1.729 | 0.553 | 1.729 | 0.0 | 1.729 | -0.838 |
| 23 | LLWRARM | 10.56 | ELBOW-WRIST LGTH | 1.100 | 0.0 | 1.100 | 0.0 | 1.100 | 0.0 |
| 24 | LGRIP | 2.00 | HAND LENGTH | 2.004 | 0.0 | 0.540 | 0.0 | 3.759 | 1.759 |
| 25 | LFNRCH | 4.69 | HAND LENGTH | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 26 | LFNGRTIP | 7.52 | HAND LENGTH | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 27 | MHIP-RHP | 3.43 | HIP BREADTH | 3.240 | -0.166 | 3.240 | 0.0 | 4.097 | -0.118 |
| 28 | RUPRLEG | 17.02 | BUTTOCK-KNE LGTH | 2.156 | 0.0 | 2.156 | -0.104 | 2.156 | -0.104 |
| 29 | RLWRLEG | 16.15 | KNEE HGT/SITTING | 1.400 | 0.0 | 4.400 | 0.0 | 1.400 | 0.0 |
| 30 | RANKLE | 2.21 | KNEE HGT/SITTING | 5.315 | -3.306 | 1.921 | 0.0 | 1.277 | 0.0 |
| 31 | MHIP-LHP | 3.43 | HIP BREADTH | 3.240 | -0.166 | 3.240 | 0.0 | 4.097 | -0.118 |
| 32 | LUPRLEG | 17.02 | BUTTOCK-KNE LGTH | 2.156 | 0.0 | 2.156 | -0.104 | 2.156 | -0.104 |
| 33 | LLWRLEG | 16.15 | KNEE HGT/SITTING | 1.400 | 0.0 | 4.400 | 0.0 | 1.400 | 0.0 |
| 34 | LANKLE | 2.21 | KNEE HGT/SITTING | 5.315 | -3.306 | 1.921 | 0.0 | 1.277 | 0.0 |

Figure 80. Printed Output of the Two Selected Independent Variable Values Calculated by CBM06.

(3) Negative numbers for decreased enfleshment density.

Now the man-model is displayed with the changed enfleshment density.

OFF - Assumes enfleshment density code zero and displays the man-model with normal enfleshment density as shown in Figure 2.

State Switch 19: Change Size of Visibility Plot

ON - Allows user to input scale factor for the visibility plot. See Paragraph 2.2.7 for details.

OFF - Assumes scale factor "1.0" and produces a visibility plot with a scale of 0.04 inches per degree or a 7.2 x 14.4 inches plot.

State Switch 20: Print Crewstation Data

ON - Prints the 3-D coordinate data of the crew station or visibility data base member. See Paragraph 2.2.7 for details.

State Switch 21: Reset After Zoom

ON - When the user gets out of the ZOOM function, the display changes from "zoomed" to normal scale.

OFF - When the user gets out of the ZOOM function, the "zoomed" display is retained until the display is regenerated, as with a "Change View".

State Switch 22: Read Anthropometric Dimensions from Cards

ON - While selecting 12 anthropometric surface dimensions to create the man-model, the user has the option to read the data from Unit 5.

OFF - User cannot read anthropometric dimensions from Unit 5.

State Switch 23: Change Crewstation Data Base Set

ON - Allows user to choose crew station geometry data from Unit 4 (see CBMCM2 in Paragraph 5.1); this is the "new" crew station data base.

OFF - Allows user to choose crew station geometry data from Unit 3, or the old data bases created for Version 5 and previous (using CBMCM in Paragraph 5.1).

State Switch 24: Change Coordinate System

ON - If state switch 23 is ON, the IDENTIFY OBJECT function will display panel coordinate data in Aircraft coordinate system.

OFF - IDENTIFY OBJECT function will display panel coordinate data in COMBIMAN coordinate system, that is, relative to Seat Reference Point.

State Switch 72: Print Transformation Information (Euler Angles)

ON - Prints out the transformation equations and matrix elements for all the links of the man-model (see Figure 81).

STOMACH , HEIRARCHY= 3

$$\begin{bmatrix} 0.94 & 0.0 & -0.35 \\ 0.0 & 1.00 & 0.0 \\ 0.35 & 0.0 & 0.94 \end{bmatrix} = \begin{bmatrix} 0.59 & 0.0 & 0.81 \\ 0.0 & 1.00 & 0.0 \\ -0.81 & 0.0 & 0.59 \end{bmatrix} \times \begin{bmatrix} 0.27 & 0.0 & -0.96 \\ 0.0 & 1.00 & 0.0 \\ 0.96 & 0.0 & 0.27 \end{bmatrix}$$

$$\begin{bmatrix} 2.71 \\ 0.0 \\ 7.78 \end{bmatrix} = \begin{bmatrix} 0.94 & 0.0 & -0.35 \\ 0.0 & 1.00 & 0.0 \\ 0.35 & 0.0 & 0.94 \end{bmatrix} \times \begin{bmatrix} 0.0 \\ 0.0 \\ 4.85 \end{bmatrix} + \begin{bmatrix} 4.41 \\ 0.0 \\ 3.24 \end{bmatrix}$$

STOMACH , HEIRARCHY= 3 JOINT CENTER ROTATED BY ROLL, PITCH, YAW

$$\begin{bmatrix} 0.0 \\ -2.71 \\ 7.78 \end{bmatrix} = \begin{bmatrix} 0.0 & 1.00 & 0.0 \\ -1.00 & 0.0 & 0.0 \\ 0.0 & 0.0 & 1.00 \end{bmatrix} \times \begin{bmatrix} 2.71 \\ 0.0 \\ 7.78 \end{bmatrix}$$

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5.46 | -3.04 | 7.96 | -5.46 | -3.04 | 7.96 | 0.0 | -3.04 |
| 11.84 | 0.0 | -3.04 | 4.08 | 1.35 | -3.04 | 11.71 | -1.35 |
| -3.04 | 4.20 | 1.35 | -3.04 | 4.20 | -1.35 | -3.04 | 11.71 |
| 2.63 | -3.04 | 11.35 | -2.63 | -3.04 | 4.57 | 2.63 | -3.04 |
| 4.57 | -2.63 | -3.04 | 11.35 | 3.76 | -3.04 | 10.77 | -3.76 |
| -3.04 | 5.14 | 3.76 | -3.04 | 5.14 | -3.76 | -3.04 | 10.77 |
| 4.65 | -3.04 | 10.00 | -4.65 | -3.04 | 5.92 | 4.65 | -3.04 |
| 5.92 | -4.65 | -3.04 | 10.00 | 5.25 | -3.04 | 9.05 | -5.25 |
| -3.04 | 6.86 | 5.25 | -3.04 | 6.86 | -5.25 | -3.04 | 9.05 |

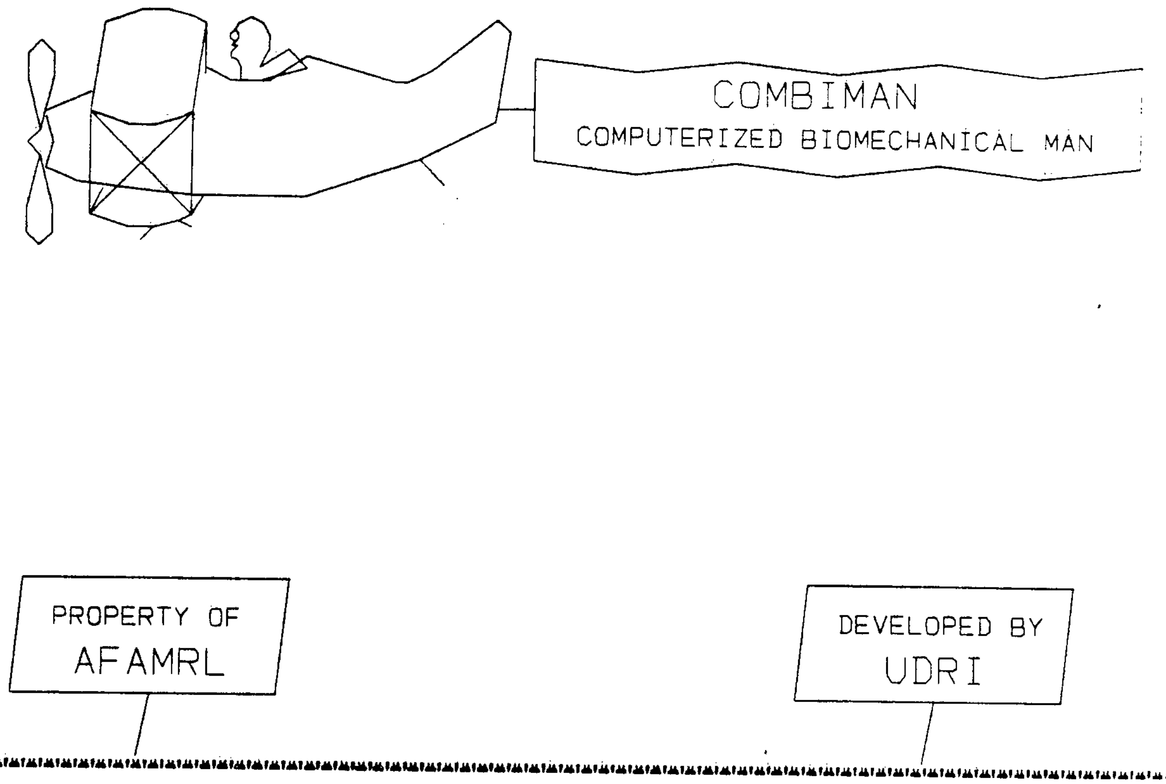
Figure 81. Transformation Equation Developed for Positioning Stomach Link (Set State Switch 72 ON).

### 2.2.28 RESTART PROGRAM Function (PFK30)

The RESTART PROGRAM function allows the user to start program CBM07 over again. When this function is evoked, all State Switches, Anthropometric dimensions, and crew station data are reset. Note that any modifications made to link lengths, link angles, or crew station definitions before depressing PFK30 are lost. The message "CBM003I PROGRAM RESTART" is written on output Unit 8.

2.2.29 END PROGRAM Function (PFK31)

The END PROGRAM function displays the COMBIMAN Banner and terminates the program CBM07, prints data on output unit 6 and messages on output unit 8.




END OF COMBIMAN PROGRAM

## 2.3 EXECUTING THE JOB

This sequence is intended to assist the user to load the program CBM07, to specify processing, to handle error procedures, to obtain output, and to end the program. It will not describe data formats and program functions because they are described in detail in Paragraph 2.2 of this section.

### 2.3.1 Loading the Program CBM07

The Job Control Cards to load the program CBM07 are shown in Figure 82. The program begins execution of CBM07 by displaying the COMBIMAN banner during the initialization. When initialization is complete, the message "LIGHT-PEN REGRESSION MEMBER" is displayed. Sequence of steps is identical to Paragraph 2.2 (reference Figure 9). The processing performed by enabled or lighted function keys is explained in Paragraph 2.2.

Anthropometric and crew station geometry data necessary to execute the interactive program CBM07 are created and maintained by the programs CBMAM, CBMCM, and CBMVM described in Sections 4, 5, and 6. The user may select data from these data bases or may modify them to suit the situation. All interactions with the program are done through the Program Function Keyboard, the Alphanumeric Keyboard, and the Light Pen.

The COMBIMAN program CBM07 requires a minimum buffer region of 16K to display the man-model and crew station, but 20K may be required for larger crew station.

If the user installation has more than two IBM 2250-3 or equivalent display terminals connected to a display control unit like IBM 2840-2 with 32K buffer distributed equally among the display terminals, it may not be possible to bring the man-model and crew station up on the screen. One solution to this problem may be to change the number value for the NUMSECT parameter in the SYSGEN IODEVICE Macro to IODEVICE UNIT=2250,...,NUMSECT=1.

```
//COMBIMAN JOB  AFAMRL,HESS,MSGCLASS=A
//JOBLIB    DD   DSN=COMBIMAN.LOADLIB,DISP=SHR
//STEP1    EXEC PGM=CBM06,REGION=650K
//* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
//*           THE INITIALIZATION, ANTHROPOMETRIC, CREWSTATION,    *
//*           AND VISIBILITY DATASETS ARE ASSUMED TO BE           *
//*           RESIDING ON DISK AND ARE CATALOGED. THEIR           *
//*           DCB AND SPACE PARAMETERS ARE GIVEN AS COMMENTS.     *
//* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
//FT01F001 DD  DSN=COMBIMAN.INITDATA,DISP=SHR
//*           DCB=(RECFM=VBS,LRECL=150,BLKSIZE=3200),             *
//*           SPACE=(TRK,(1,1)),UNIT=DISK,VOL=DISK01              *
//FT02F001 DD  DSN=COMBIMAN.ANTHDATA,DISP=SHR
//*           DCB=(RECFM=F,LRECL=248,BLKSIZE=248),                *
//*           SPACE=(TRK,(50,10)),UNIT=3330,VOL=DISK01            *
//FT03F001 DD  DSN=COMBIMAN.CRSTDATA,DISP=SHR
//*           DCB=(RECFM=F,LRECL=368,BLKSIZE=368),                *
//*           SPACE=(TRK,(70,10)),UNIT=3330,VOL=DISK01            *
//FT04F001 DD  DSN=COMBIMAN.CRSTCAT1,DISP=SHR
//*           DCB=(RECFM=F,LRECL=624,BLKSIZE=624),                *
//*           SPACE=(TRK,(100,20)),UNIT=3330,VOL=DISK01           *
//FT05F001 DD  DSN=COMBIMAN.SMPLANTH,DISP=SHR
//*           DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200),               *
//*           SPACE=(TRK,(1,1)),UNIT=3330,VOL=DISK01              *
//FT06F001 DD  SYSOUT=A
//FT07F001 DD  SYSOUT=B
//FT08F001 DD  DISP=(,PASS),SPACE=(1210,(25,10)),UNIT=SYSDA,
//             DCB=(LRECL=121,RECFM=FB,BLKSIZE=1210)
//FT09F001 DD  DSN=COMBIMAN.VISBDATA,DISP=SHR
//*           DCB=(RECFM=F,LRECL=240,BLKSIZE=240),                *
//*           SPACE=(TRK,(15,5)),UNIT=3330,VOL=DISK01             *
//FT10F001 DD  UNIT=1E0
//*           ADAGE 4250 OR IBM 2250-3 COMPATIBLE TUBE            *
//FT11F001 DD  DSN=COMBIMAN.PLOTDATA,DISP=SHR
//*           DCB=(RECFM=F,LRECL=80,BLKSIZE=800),                 *
//*           SPACE=(TRK,(2,1)),UNIT=3330,VOL=DISK01              *
//* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
//*           JCL FOR AN ONLINE VERSATEC PLOTTER                  *
//* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
//PLOTPARM DD  DSN=SYS1.PARMLIB(PLOTPARM),DISP=SHR
//PLOTLOG  DD  DUMMY
//VECTR1   DD  DSN=&&VECTR1,UNIT=DISK,SPACE=(TRK,(1,1)),DISP=(,PASS)
//VECTR2   DD  DSN=&&VECTR2,UNIT=DISK,SPACE=(CYL,(1,1)),DISP=(,PASS)
//SYSVECTR DD  UNIT=0EE,DCB=(LRECL=133,RECFM=FA,BLKSIZE=133),
//             UCS=T11,FCB=STD1
//SYSABEND DD  SYSOUT=A
//SYSUDUMP DD SYSOUT=A
//* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
//*           PRINT COMBIMAN MESSAGES FROM UNIT 8                 *
//* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
//PRINT    EXEC PGM=IEBGENER,COND=EVEN
//SYSPRINT DD  DUMMY
//SYSIN    DD  DUMMY
//SYSUT1   DD  DSN=*.STEP1.FT08F001,DISP=(OLD,DELETE)
//SYSUT2   DD  SYSOUT=A,DCB=(BLKSIZE=121,RECFM=FA)
//
```

Figure 82. JOB CONTROL CARDS to Execute CBM07.

This assignment allocates 2K bytes of buffer space to each tube in a four-tube configuration with approximately 24K available on a first-come, first-serve basis.

### 2.3.2 Error Procedures

The program CBM07 performs some preliminary error checking on the data supplied by the user. The majority of checking is performed for data values which are outside the limits built into the program or the wrong type (i.e. alpha or numeric). For example: state switch numbers must be between 1 and 72; the maximum number of panels for any crew station configuration to be displayed cannot exceed 250; and all anthropometric dimensions entered must be positive values. When the user light-pens or types in values which are out of range, the program prompts the user to retry the entry. Numerical values can be typed with or without a decimal point, at the user's option.

Example 1. Enter Panel type 3.
This can be done in any one of the following ways.
(a) Type "3" and depress ALT-CODE/5.
(b) Type "3." and depress ALT-CODE/5.
(c) Type "3.0" and depress ALT-CODE/5.
If the program expects a whole number, decimal values are rounded off to the nearest integer. Example 3.4 and 2.7 are rounded off to 3.
If the program expects two decimal places, the input number is rounded off accordingly.
Example 2. Change a value in the link table from 10.50 to 11.32.
Light-pen 10.50, then Type "11.32" and depress ALT-CODE/5.
Typing "11.319" or "11.3215" and depressing ALT-CODE/5 has the same effect as entering 11.32.

If a Program Function Key is depressed the corresponding function as described in Paragraph 2.2 is enabled. However, if a key is pressed erroneously, the following procedure may be followed to return to the main program.

For Program Function Keys 0, 1, 2, 3, 6, 7, 8, 11, 14, 16, 18, 28, and 29 depress ALT-CODE/5 to cancel the selected function.

With Program Function Keys 4, 12, 13, and 27 the function must be executed.

For Program Function Key 5, light-pen "*NONE*" in the display to cancel the execution of the RETRIEVE CREW STATION function.

For Program Function Key 22, depress the temporarily defined PFK2 or PFK10 to return to the main graphics routine.

### 2.3.3 Ending the Program CBM07

There are three ways to end program CBM07. The primary method for terminating the program is through CBM07, by depressing the END PROGRAM function key PFK31. This option can be exercised only when the message "DEPRESS PFK TO SELECT FUNCTION" appears in the Prompting Area of the CRT. Another method to terminate execution of the program is to use the CANCEL key on the IBM 2250 Alphanumeric Keyboard. When CANCEL key and ALT-CODE key are depressed together, (on the Adage keyboard, depress CNTL and C keys together) the three options shown in Figure 83 are displayed.

Light-penning the "TERMINATE" option terminates the program without producing a memory dump of program CBM07. The "DUMP" option terminates the program and produces a full storage dump. The "RESUME" resumes the execution of program CBM07 as though the CANCEL key has not been used. This option is provided by the system and can be used at any time.

The third option is to cancel the JOB from the computer operator's console. This is a system dependent option.

< TERMINATE

< DUMP

< RESUME

Figure 83. Options Displayed on Depressing ALT-CODE and CANCEL Keys Together.

## 2.4 PROGRAM MESSAGES-INFORMATION AND ERROR TYPES

The program CBM07 prints out both information and action oriented messages. The message format is as follows:

CBMOnni      Message Text

where:

| | |
|---|---|
| CBM | identifies the message and indicates that the message originates from the COMBIMAN system, |
| O | identifies the message and indicates that the message originates from the program CBM07, |
| nn | is the message number, |
| i | is the action code (I=information, A=action to be performed), and |
| message text | is the message text. |

The messages are as follows:

CBM001I COMBIMAN V6, DATE=MM/DD/YY, TIME=hh.mm.ss.

| | | |
|---|---|---|
| | Issued By: | CBMINT. |
| | Reason: | Program CBM07 started at this date and time. |
| | System Action: | Execution continues. |
| | User Action: | None. |

CBM002I PROGRAM END.

| | | |
|---|---|---|
| | Issued By: | CBMRTS. |
| | Reason: | The user requested the END PROGRAM function. |
| | System Action: | The program ended as requested. |
| | User Action: | None. |

CBM003I PROGRAM RESTART

| | | |
|---|---|---|
| | Issued By: | CBMRTS. |
| | Reason: | The user requested the RESTART PROGRAM function. |
| | System Action: | The program restarted as requested. |
| | User Action: | None. |

CBM007I Panel number. PANEL NAME: panel number, TYPE=nn, nn VERTICES.

| | | |
|---|---|---|
| | Issued By: | CBMPNL or CBMCRW |
| | Reason: | The user defined a panel through the DESIGN PANEL function. |
| | or | The user requested the crew station data by setting state switch 2 "ON". |
| | System Action: | The defined panel is accepted or the crew station data are printed. |
| | User Action: | None. |

CBM009I SWITCH switchnumber ON/OFF

| | | |
|---|---|---|
| | Issued By: | CBMSSW. |
| | Reason: | The user requested a change in the execution of the program using the STATE SWITCH function. |
| | System Action: | Switch switchnumber is now either "ON" or "OFF". |
| | User Action: | None. |

CBM010I IDENTIFIED objectname

Issued By: CBMIOI.

Reason: The user requested the IDENTIFY OBJECT function to identify an object displayed on the screen.

System Action: The system displays the name of the object, the coordinates of the distal-end point and the internal "key" number.

User Action: None.

CBM011I OMITTED objectname

Issued By: CBMIOI.

Reason: The user requested that an object be removed from the display using the "OMIT OBJECT" function.

System Action: The light-penned object is removed from the screen, and the name of the object, coordinates of the distal-end point, and the internal "key" number are displayed on the screen.

User Action: Record the internal "key" number in order to include the object in the display at a later time.

CBM012I INCLUDED objectname

Issued By: CBMIOI.

Reason: The user requested that an object be included back into the display using the INCLUDE OBJECT function.

System Action: The requested object is included back into the display.

User Action: None.

CBM014I CREW STATION DATA FROM membername

Issued By: CBMCRW.

Reason: The user requested the retrieval of a crew station definition by the RETRIEVE CREW STATION function.

System Action: The requested crew station member is retrieved.

User Action: None.

CBM015I SURVEY DATA FROM membername

Issued By: CBMIN1.

Reason: The user requested membername Survey Data from the Anthropometric Data Base.

System Action: The requested survey data are retrieved.

User Action: None.

CBM016I VIEW=(roll, pitch, yaw), SCALE=factor, OFFSET=(x,y,z).

| | |
|---|---|
| Issued By: | CBMCVW. |
| Reason: | The user requested a new off-axis view through the "CHANGE VIEW" function. |
| System Action: | The display is rotated as specified. |
| User Action: | None. |

CBM018I INITIALIZATION DATA MISSING.

| | |
|---|---|
| Issued By: | CBMINT. |
| Reason: | Initialization Data could not be found. |
| System Action: | The program is terminated. |
| User Action: | Check to see that initialization data set has not been destroyed. |

CBM019I PLOTS COMPLETED.

| | |
|---|---|
| Issued By: | CBMCP1. |
| Reason: | The requested hard copy plot of the COMBIMAN display is finished. |
| System Action: | Continue processing. |
| User Action: | None. |

CBM022A TOO MANY PANELS/VERTICES.

| | |
|---|---|
| Issued By: | CBMCRW. |
| Reason: | More panels were defined through the RETRIEVE CREW STATION function (PFK5) or the DESIGN PANEL function (PFK16) than could be handled at one time. The maximum number of panels that can be handled at one time is 250. |
| System Action: | The panel being defined is ignored. |
| User Action: | Delete a few panels by the DELETE PANEL function (PFK18) or delete a crew station using the RETRIEVE CREW STATION function before defining more panels. |

CBM026I DELETE PANEL panelname.

| | |
|---|---|
| Issued By: | CBMDPL. |
| Reason: | The user requested to delete panel panelname using the DELETE PANEL function. |
| System Action: | The panel is deleted. |
| User Action: | None. |

CBM031A CREW STATION DATABASE MISSING.

| | |
|---|---|
| Issued By: | CBMCRW. |
| Reason: | Identification record of the file containing a crew station data is missing. |
| System Action: | Displays similar message to CRT and returns control to main program. |
| User Action: | Stop program, if crew stations are needed. |

CBM033I REGRESSION VALUES FROM MEMBER membername.

| | |
|---|---|
| Issued By: | CBMIN1. |
| Reason: | User entered a valid regression type 0 anthropometric data base membername using light-pen. |
| System Action: | Data from the referenced member are read. |
| User Action: | None. |

CBM034A ANTHROPOMETRIC DATA BASE MISSING.

| | |
|---|---|
| Issued By: | CBMINT, CBMIN1. |
| Reason: | The identification record of the file which contains anthropometric data is missing. |
| System Action: | Displays similar message on CRT and returns control to main program. |
| User Action: | Stop program; create Anthropometric Data Base. |

CBM035A VARIABLE NO. nn OF REGRESSION SURVEY membername HAS INVALID UNIT OF uu.

| | |
|---|---|
| Issued By: | CBMIN1. |
| Reason: | The unit of measurement read in for the specified variable and survey was not either IN, CM, MM, LB, or KG. |
| System Action: | Remainder of data for variable is read in. |
| User Action: | Report condition to systems programmer. |

CBM039I UNIT OF VARIABLE vblname HAS BEEN CHANGED TO uu.

| | |
|---|---|
| Issued By: | CBMIND, CBMDEP. |
| Reason: | The user changed the default unit of measurement of the selected variable. |
| System Action: | Flag the unit as being changed. |
| User Action: | None. |

CBM040A INVALID UNIT OF uu SPECIFIED FOR VARIABLE vblname.

| | |
|---|---|
| Issued By: | CBMIND, CBMDEP. |
| Reason: | User has indicated that values for anthropometric survey as having a length of weight type of measurement. The unit specified by the user was not consistent with the original definition. |
| System Action: | Changed ignored. |
| User Action: | Specify correct unit or keep default unit. |

CBM041I INPUT VARIABLES WILL BE IN PERCENTILES.

| | |
|---|---|
| Issued By: | CBMIND, CBMDEP. |
| Reason: | User had indicated that values for anthropometric variables will be given as percentiles. |
| System Action: | None. |
| User Action: | None. |

CBM042I INPUT VARIABLES WILL BE IN ABSOLUTE VALUES.

| | |
|---|---|
| Issued By: | CBMIND, CBMDEP. |
| Reason: | User has indicated that values for anthropometric variables will be given in engineering units. |
| System Action: | None. |
| User Action: | None. |

CBM043I USER CHOOSES TO INPUT nn DEPENDENT VARIABLES.

| | |
|---|---|
| Issued By: | CBMDEP. |
| Reason: | User has depressed PFK12, indicating the decision to enter values for all the dependent anthropometric variables. |
| System Action: | None. |
| User Action: | None. |

CBM044I STANDARD ERROR MULTIPLICATION FACTOR RESET TO nnn.nn.

| | |
|---|---|
| Issued By: | CBMIND. |
| Reason: | User has entered a new value for standard error of estimate. |
| System Action: | Value changed internally. |
| User Action: | None. |

CBM045I USER CHOOSES TO INPUT 2 INDEPENDENT VARIABLES.

| | |
|---|---|
| Issued By: | CBMIND. |
| Reason: | User has depressed PFK13, indicating the decision to enter values for two independent anthropometric variables. |
| System Action | None. |
| User Action: | None. |

CBM046A ANTHROPOMETRIC DIMENSION vblname REFERENCED BY LINK link name DOES NOT EXIST IN MEMBER membername.

| | |
|---|---|
| Issued By: | CBMIN1. |
| Reason: | One of the vital anthropometric dimensions needed to generate the link length in question does not exist in the referenced survey member. |
| System Action: | Program ends. |
| User Action: | Print contents of referenced member from Anthropometric Data Base, using PRT function of CBMAM. |

CBM047A ABNORMAL PROGRAM END.

| | |
|---|---|
| Issued By: | CBMIN1. |
| Reason: | Key data vital to the construction of the man-model were not available. |
| System Action: | Program ends. |
| User Action: | Contact systems programmer. |

CBM048I DATA WRITTEN FOR OFF-LINE PLOT NO. nn.

| | |
|---|---|
| Issued By: | CBMCP1. |
| Reason: | Coordinate and index data for man-model and crew station configuration have been written onto disk file specified by FT11F001 DD card. nn. is the plot number. |
| System Action: | None. |
| User Action: | None. |

CBM049A I/O ERROR ON UNIT 11. OFF-LINE PLOT DATA nn NOT SAVED.

| | |
|---|---|
| Issued By: | CBMCP1. |
| Reason: | Input-output error on file where coordinate data are written. Plot data for plot nn are not saved. |
| System Action: | Return to calling program. |
| User Action: | None. |

CBM052I VISIBILITY PLOT GENERATED FOR visibility member.

Issued By: CBMVIS.

Reason: Successful completion of visibility plot.

System Action: None.

User Action: None.

CBM053A NUMBER OF COMBINATIONS OF INDEPENDENT VARIABLES SUPPLIED BY MEMBER survey name DOES NOT EQUAL THAT SUPPLIED BY MEMBER regression name.

Issued By: CBMIN1.

Reason: Values for number of independent combinations are different from number supplied by regression member.

System Action: Values supplied by regression member are used.

User Action: Contact systems programmer.

CBM054A NUMBER OF DEPENDENT VARIABLES SUPPLIED BY MEMBER survey name DOES NOT EQUAL THAT SUPPLIED BY MEMBER regression name.

Issued By: CBMIN1.

Reason: Values for number of dependent variables are different from number supplied.

System Action: Values supplied by regression member are used.

User Action: Contact systems programmer.

CBM055I UNIT 9 NOT A VISIBILITY DATA BASE.

Issued By: CBMVIS.

Reason: Identification record of Visibility Data Base is missing.

System Action: Terminates Visibility Plot Function.

User Action: Stop program if Visibility Plot is needed.

CBM056I TOO MANY VERTICES nn FOR BOUNDARY boundary name.

Issued By: CBMVIS.

Reason: The number of vertices on boundary exceeded 100.

System Action: Unpredictable result on Visibility Plot.

User Action: Limit number of vertices on any one boundary to 100.

CBM057I TOO MANY POINTS nn FOR BOUNDARY boundary name.

| | |
|---|---|
| Issued By: | CBMVIS. |
| Reason: | The number of points on any boundary exceeded 2500 (ie. the perimeter of the boundary exceeded 2500 inches). |
| System Action: | Unpredictable result on Visibility Plot. |
| User Action: | Limit the perimeter of the boundary to 2500 inches. |

CBM058I END OF DATA ON UNIT 9.

| | |
|---|---|
| Issued By: | CBMVIS. |
| Reason: | Insufficient data on Unit 9 to generate visibility plot. |
| System Action: | Return to calling program. |
| User Action: | Contact systems programmer. |

## SECTION 3

## OFF-LINE PLOT PROGRAM (CBMOFF)

The CBMOFF is an off-line plot program which plots COMBIMAN data displayed on the IBM 2250 screen. When the user needs a plot which cannot be done On-Line,[1] the OFF-LINE PLOT COMBIMAN function (PFK7) is depressed to store the man-model and crew station data of the display currently on the CRT (see Paragraph 2.2.8). The user may store as many sets of these data as needed on data set unit 11 (see FT11F001 DD card on Figure 82). Program CBMOFF plots these data using Calcomp compatible software. The user specifies the data sets to be plotted, as well as plot size, color, and content.

The following information in intended as a programmer's guide to use the program CBMOFF.

### 3.1 PROCESSING CAPABILITIES

The user specifies the contents and size of the plot as well as its color. This is done by providing the following two input cards along with the plot data file.

(1) the NAMELIST/CNTRL/, and

(2) a card with the plot numbers of those data sets not to be plotted.

The information supplied on these cards allows the user to vary plot size, plot color, and plot content as follows:

---

[1] At WPAFB AFAMRL we use a, 22" Model Versatec electrostatic plot for On-Line plots and a 4-color Calcomp 1012 plotter for report quality output and quarter-scale Off-Line plots.

(1) The NAMELIST/CNTRL/'s variables and their default values:

FACTR - When specified, FACTR is the plot scale factor for that program run, otherwise, the scale factor specified for each plot during the COMBIMAN run when the data were generated (see Paragraph 2.2.8) is used.

IPLINK, IPFLES, and IPWKSP - These three variables allow user to eliminate the link system, the enfleshment, and/or the crew station respectively from plots for that program run. Specifying IPLINK, IFLES and/or IPWKSP equal to "1" deletes that element(s) from the plots. Using the default values

IPLINK=0
IPFLES=0, and
IPWKSP=0

all elements on the CRT display are plotted.

ICBANN, ICLINK, ICFLES, ICWKSP determines the pen color for elements of the plot where,

ICBANN is the plot banner,
ICLINK is the link system,
ICFLES is the enfleshment, and
ICWKSP is the crew station.

The default[2] values of the pen colors for plot banner, link system, enfleshment and crew station are:

ICBANN=1 for banner,
ICLINK=1 for link system,
ICFLES=2 for enfleshment, and
ICWKSP=3 for crew station.

---

[2] When an off-line plot is made, the user specifies the color assignments.

[3] The & symbol is used while executing the program on an IBM computer: other computers may have different symbols for this purpose.

The format of the Namelist CNTRL is as follows (see Figure 84):

| | |
|---|---|
| column 1 | - a blank |
| column 2 | - a & |
| columns 3-7 | - the word CNTRL |
| column 8 | - a blank |

After column 8 comes none, all, or any combination of the keyword control variables in the form FLESH=1, FACTR=.95, ICLINK=3,..., the last one followed by a "&END" indicating the end of the NAMELIST variable input. NOTE: This data card must appear.

(2) The second data card contains the plot numbers of the data to be skipped. The format for the data card is shown in Figure 85. The data card can contain up to twenty plot numbers, each right-justified integer in one of the 3-character fields in the first sixty columns of the card. These numbers can be in any order and do not need to fill consecutive fields. If the card is left blank, no plot will be skipped.

Figure 86 shows an Off-Line plot of the man-model and a crew station, as it appears on the CRT, and the plot banner (Figure 87) indicates that the plot is a perspective plot with scale factor 0.85. The data card input for this plot is shown in Figure 88. Notice that all values except IPFLES and IPWKSP remain at their default values in the NAMELIST/CNTRL/. This implies that the scale factor for the plot is the one specified during the COMBIMAN run when the plot data were generated. The link system, enfleshment, and crew station as displayed on the CRT are included in the plot. Since both ICFLES and ICWKSP are set equal to 1 in the input, all elements of the plot will be of the same color (in this case black). Also notice that the second input card contains a "1" in column six denoting that plot number 1 is to be skipped. The plot shown in Figure 86 is plot number "2" as indicated in Figure 87.

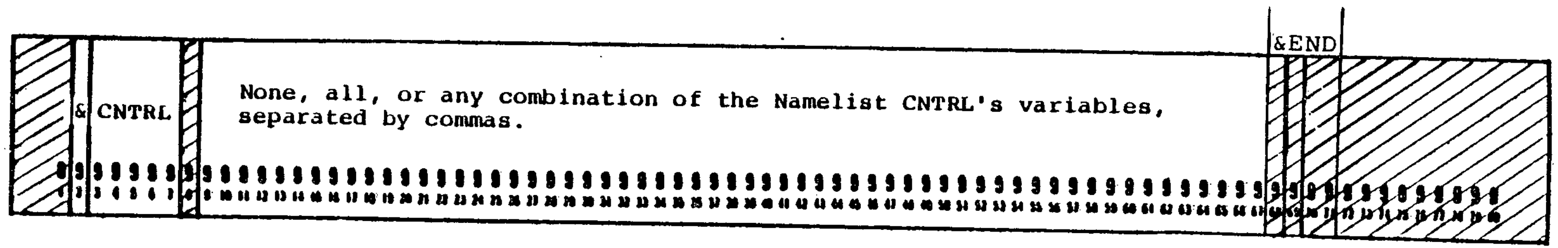



Figure 84. The Format of the Namelist CNTRL.

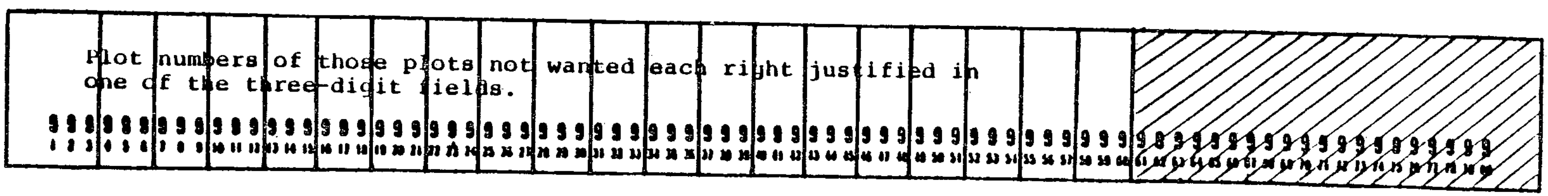



Figure 85. The Format of the Data Card for Unwanted Plots.

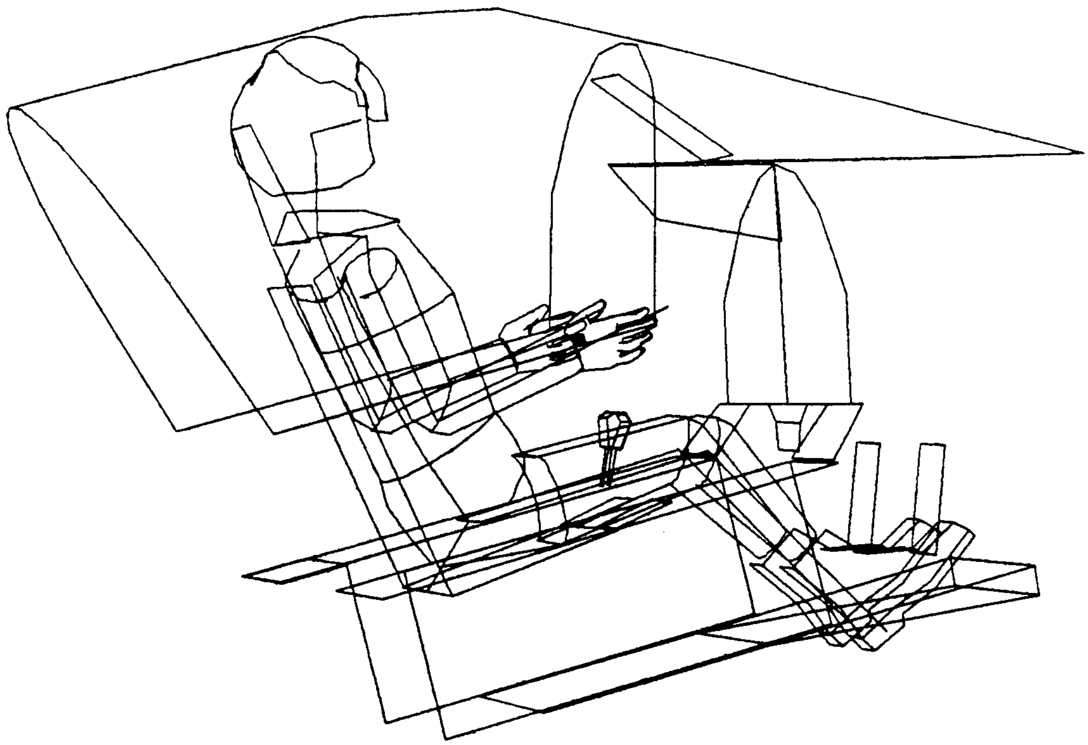


Figure 86. COMBIMAN OFF-LINE Plot.

SURVEY:67 USAF CREWSTATION:A7--SEAT DATE: 11/ 8/85
VIEW-PLANE: OFF AXIS ROLL:0.0 PITCH:-15.0 YAW:15.0
PERSPECTIVE PLOT SCALE:0.85
PLOT NUMBER: 2

Figure 87. Plot Banner.

Card 1

&CNTRL ICWKSP=1,IPFLES=1 &END

Card 2

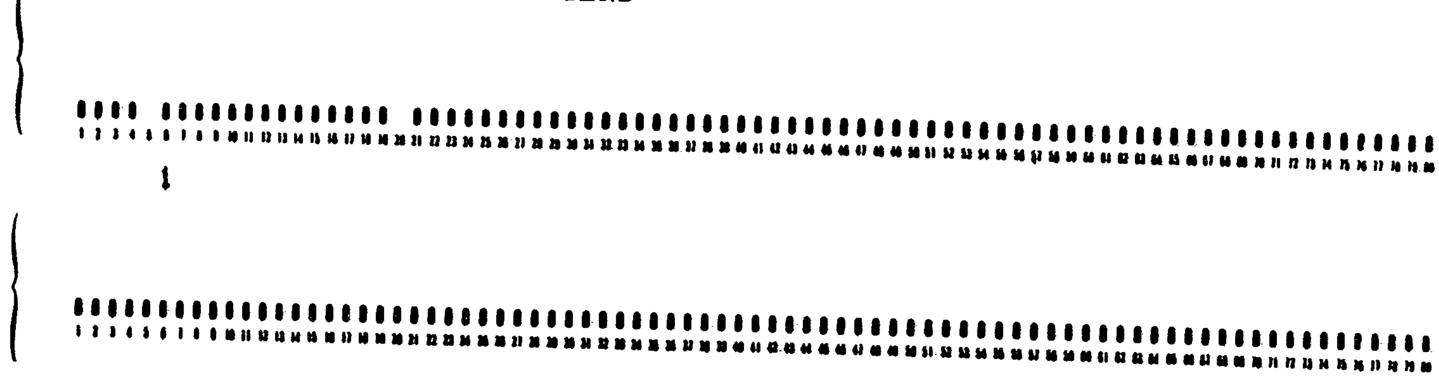


Figure 88. Card Input for Figure 86.

Card 1

&CNTRL ICWKSP=1,IPFLES=1,FACTR=0.55 &END

Card 2

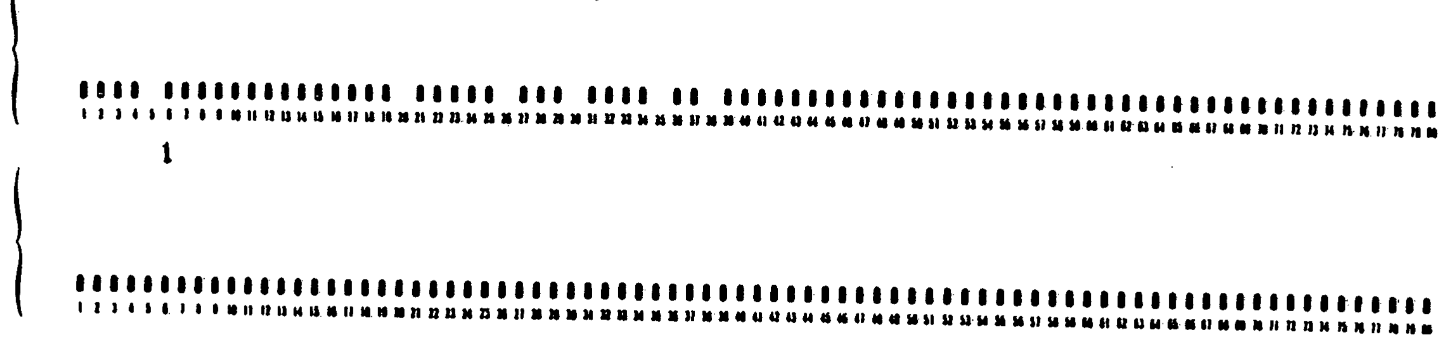


Figure 89. Card Input for Figure 90.

Figure 89 shows the input cards used to generate Figure 90 from the same plot data. FACTR=0.55 resets the plot scale factor to 0.55, of the original plot scale factor. IPFLES=1 deletes all enfleshment from the man-model, and the color of all plot elements is again black.

## 3.2 PROGRAM MESSAGES-INFORMATION AND ERROR TYPE

The program CBMOFF prints both information and action related messages. The message format is as follows:

CBM2nni      message text

where

| | |
|---|---|
| CBM | identifies the message and indicates that the message originates from COMBIMAN system |
| 2 | identifies the message and indicates that the message originates from the program CBMOFF |
| nn | is the message number |
| message text | is the text of the message. |

**CBM201I** PLOT SET plotnumber WAS NOT PLOTTED -- BY REQUEST.

| | |
|---|---|
| Reason: | User requested that plot plotnumber not be plotted. |
| System Action: | Plot plotnumber is not plotted. |
| User Action: | None. |

**CBM202A** INCORRECT AMOUNT OF DATA FOR PLOT plotnumber -- PROGRAM ENDING.

| | |
|---|---|
| Reason: | There was too much or too little data on file for plot plotnumber. |
| System Action: | No plotting occurs, and program ends. |
| User Action: | Recreate plot file. |

**CBM203I** SCALE FACTOR CHANGED FROM 1 TO factor2.

| | |
|---|---|
| Reason: | User input a value for FACTR (factor2) in the namelist CNTRL. |
| System Action: | Factor2 is used to scale the plot. |
| User Action: | None. |

SURVEY:67 USAF CREWSTATION:A7--SEAT DATE: 11/ 8/85
VIEW-PLANE: OFF AXIS ROLL:0.0 PITCH:-15.0 YAW:15.0
PERSPECTIVE PLOT SCALE:0.47
PLOT NUMBER: 2

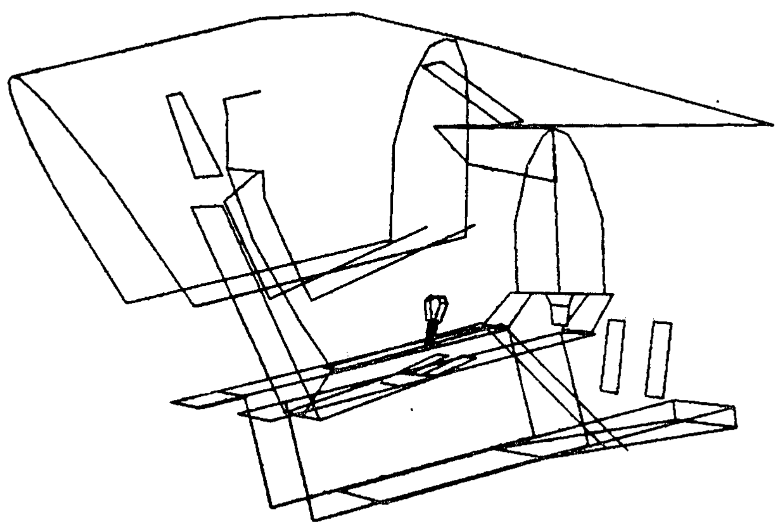


Figure 90. Altered COMBIMAN OFF-LINE Plot.

## SECTION 4

## COMBIMAN ANTHROPOMETRIC DATA BASE MAINTENANCE PROGRAM (CBMAM)

The COMBIMAN program has a number of anthropometric surveys already programmed and provided to the user (see RETRIEVE ANTHROPOMETRY function, PFK4). If the user requires an additional survey, this section describes how to create the data base using the supplied utility program, CBMAM. This data base resides on a direct-access disk, and contains anthropometric survey and regression data which are relevant to generate the man-model.

The information on the Data Base is organized into groups of related records called members. Members may be either regression data, or anthropometric survey data. Data for survey members are generally subsets of existing anthropometric surveys in the AFAMRL Anthropometric Data Bank. In order to add a new anthropometric survey to the Data Base, the key information needed includes the mean and standard deviation for each anthropometric variable and a set of correlation coefficients for all the relevant variables of the survey.

### 4.1 PROCESSING CAPABILITIES

The program CBMAM (COMBIMAN Anthropometric Data Base Maintenance Program) allows the user to create and maintain the Anthropometric Data Base. The user supplies the input data on 80 character computer cards or in card image format on magnetic tape. The program CBMAM reads and processes the data in accordance with the selection of control commands by the user. These commands allow the user to add members to the Data Base, to delete members from the Data Base, to print or punch existing members, to list the directory of the Data Base, or to compress

the data on the file to combine unused space. The data flow of the program is shown in Figure 91.

The Anthropometric Data Base is made up of two types of related data. One type consists of regression data which are used by the interactive graphics program CBM06 to compute the anthropometric surface dimensions needed to generate the link system of the man-model. The second type consists of survey data which define the means, standard deviations, and percentiles for each variable for a particular survey. Each group of data, whether dealing with regression or survey information, is called an anthropometric member, and is referenced by its member name and type classification.

## 4.2 RESTRICTIONS AND LIMITATIONS

The Anthropometric Data Base may contain up to a maximum of 20 members consisting of regression and survey types. The number of records for each member need not be the same and the sum of the record counts for all the members cannot exceed 1979. Information on the number of members on the Data Base and their sizes are obtained by using the "+PRT" control command as explained in detail in Paragraph 4.3.2.9.

Additional limitations on the number of variables and related data are explained in Paragraph 4.3.2. Members to be added should have unique membernames. If the new membername matches with any name in the directory, the member will not be added.

## 4.3 HOW TO USE PROGRAM CBMAM

The surveys used in COMBIMAN are subsets of 1967 Survey of the USAF Flying Personnel (Churchill, et al., 1976), the 1970 Survey of the U.S. Army Aviators (Churchill, et al., 1971), the 1968 Air Force Women, and the 1964 U.S. Navy Flyers. As new

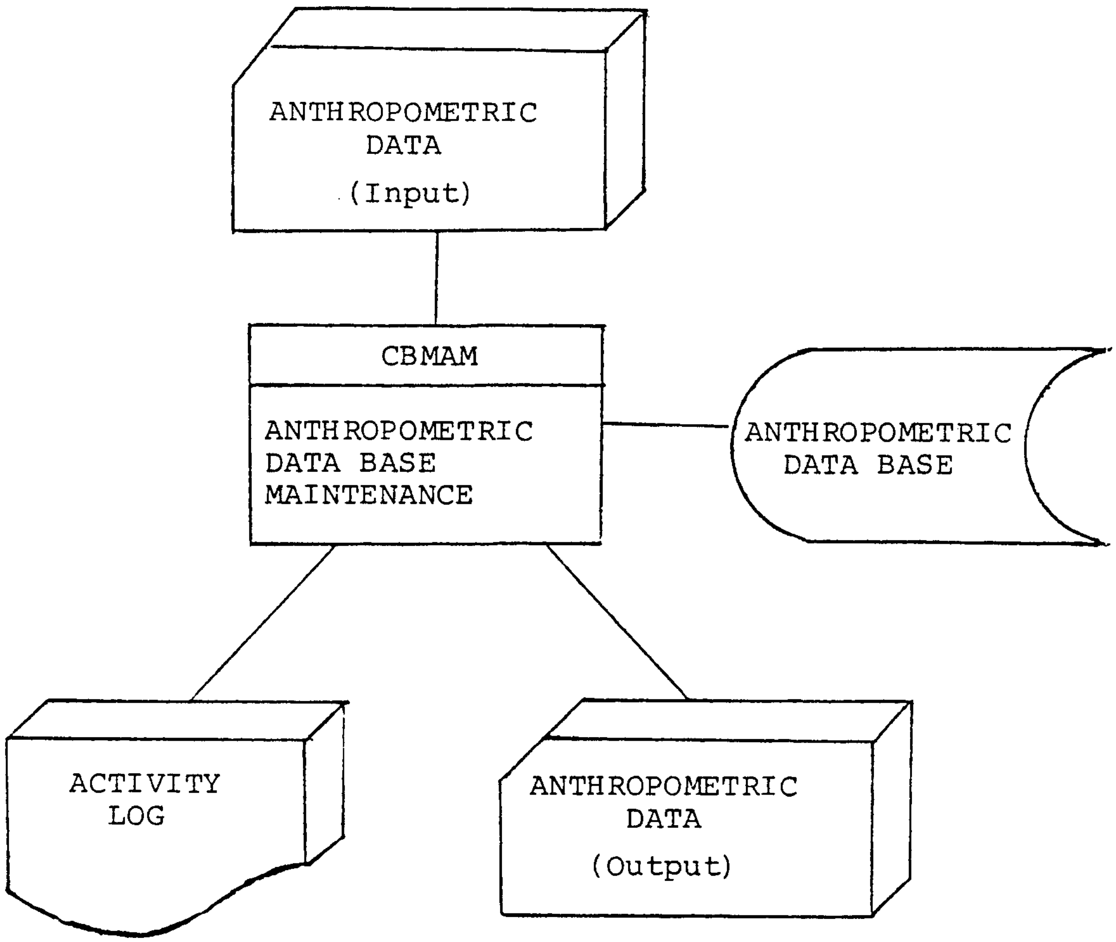



Figure 91. Data Flow for Program CBMAM.

surveys become available, or subsets of existing surveys in the AFAMRL Data Bank become needed, the program CBMAM is used to add these new members. In most cases, each new survey type member has a corresponding regression type member which contains multiple and single regression equation coefficients to predict additional anthropometric variables from those specified by the user. In a few cases, one regression type member may be referenced by several survey type members. These are special cases and this practice should not be used regularly without first consulting with personnel in the Workload and Ergonomics Branch of the Air Force Aerospace Medical Research Lab, Wright-Patterson Air Force Base, Ohio to verify the statistical accuracy of the regression data of the anthropometric survey in question.

All examples illustrating use of CBMAM will be based on the 1967 USAF Flying Personnel survey and its regression member R67 USAF.

### 4.3.1 Input Data Specification

The nucleus of the anthropometric variables considered for input as part of any anthropometric survey member is the 12 variables required to generate the 35 internal link lengths of the man-model skeletal system. The names of these variables and their abbreviated 16 character names, where applicable, are listed in Table 4. Very few COMBIMAN users will have specific values to input for each of the 12 variables. In order to accommodate this, we have selected additional anthropometric variables which are found to be good predictors of either body segment mass or body segment length, and have moderately high correlations with the 12 required variables. The variables chosen to predict mass and length related variables for the 1967 Survey are shown in the appropriate columns of Table 5. The variables in Table 6 which are both predictors and required dependent dimensions are marked with an asterisk.

## TABLE 4

## LIST OF DEPENDENT VARIABLES NEEDED TO GENERATE COMBIMAN LINK SYSTEM

| | Name | 16 Character Abbreviation (If Applicable) |
|---|---|---|
| 1. | Weight | |
| 2. | Sitting Height | |
| 3. | Acromion Height, Sitting | (ACROMION HGT/SIT) |
| 4. | Knee Height, Sitting | (KNEE HGT/SITTING) |
| 5. | Buttock-Knee Length | (BUTTOCK-NKE LGTH) |
| 6. | Shoulder Elbow Length | (SHOULDR-ELB LGTH) |
| 7. | Biacromial Breadth | (BIACROMIAL BRDTH) |
| 8. | Hip Breadth | |
| 9. | Chest Depth | |
| 10. | Foot Length | |
| 11. | Hand Length | |
| 12. | Elbow-Wrist Length | (ELBOW-WRIST LGTH) |

## TABLE 5

## LIST OF DEPENDENT VARIABLE PREDICTORS

| | Mass Related | | Length Related |
|---|---|---|---|
| 1. | *Weight | 1. | *Sitting Height |
| 2. | Bideltoid Breadth | 2. | Eye Height, Sitting |
| 3. | Hip Breadth, Sitting | 3. | *Knee Height, Sitting |
| 4. | *Chest Depth | 4. | *Buttock-Knee Length |
| | | 5. | Arm Length |
| | | 6. | Thumb-Tip Reach |
| | | 7. | Leg Length |

*Predictors and required dependent variables.

TABLE 6

LIST OF ANTHROPOMETRIC DIMENSIONS
AVAILABLE IN THE ANTHROPOMETRIC DATA BASE

1. Weight
2. Sitting Height
3. Eye Height, Sitting
4. Acromion Height, Sitting
5. Knee Height, Sitting
6. Buttock-Knee Length
7. Shoulder-Elbow Length
8. Arm Length
9. Thumb-Tip Reach
10. Biacromial Breadth
11. Bideltoid Breadth
12. Hip Breadth
13. Hip Breadth, Sitting
14. Chest Depth
15. Foot Length
16. Hand Length
17. Elbow-Wrist Length
18. Leg Length

To generate the man-model the user may also select one mass related and one length related variable from Table 5 and supply their values. The values for all the 12 variables in Table 4 are computed using the regression equations from the Anthropometric Data Base.

In order to create an anthropometric survey member, first a set of variables based on availability and necessity has to be established. Once the complete set of variables is established, the means, standard deviations, percentiles, and correlation coefficients for each variable of the particular survey may be obtained from the AFAMRL Anthropometric Data Bank. The set of variables used for the 1967 Survey is shown in Table 6. A sample data obtained for weight is shown in Figure 92.

The coefficients used in the regression equations are based on means, standard deviations and correlation coefficient for each variable, and on the equations which were developed in WADD-TR-60-31, pages 69-70 (Zeigen, et al, 1960). Tables 7 and 8 show the elements of the correlation coefficient matrices used in calculating the regression coefficients. The means, standard deviations, and correlation coefficients for the 1967 USAF survey are available in AMRL-TR-77-2 (Churchill, et al, 1978).

The total number of multiple regression equations (NR) needed for a particular survey is calculated using the following equation:

$$NR = (NM \times NL) \times ND \tag{1}$$

where NM is the number of variables related to body mass, NL is the number of variables related to body segment length, and ND is the number of dependent variables. For the 1967 Survey, each of the 28 combinations of mass-length-related dimensions has its own set of 12 multiple regression equations to compute the surface dimensions required to generate the man-model. In addition to

VARIABLE NAME: WEIGHT

MEAN: 173.60 LBS

STANDARD DEVIATION: 21.44 LBS

PERCENTILE DATA:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Percentile | 1 | 2 | 3 | 5 | 10 | 15 | 20 | 25 | 30 |
| Weight | 127.58 | 132.63 | 135.82 | 140.15 | 146.89 | 151.53 | 155.27 | 158.56 | 161.56 |
| Percentile | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 |
| Weight | 164.37 | 167.08 | 169.74 | 172.42 | 175.13 | 177.92 | 180.84 | 183.97 | 187.41 |
| Percentile | 80 | 85 | 90 | 95 | 97 | 98 | 99 | | |
| Weight | 191.32 | 195.91 | 201.83 | 210.76 | 216.62 | 220.94 | 227.73 | | |

Figure 92. Sample Data Obtained from Summary Statistics of the Air Force Rated Officers. (Churchill et al, 1976)

TABLE 7

MATRIX OF CORRELATION COEFFICIENTS BETWEEN
MASS AND LENGTH RELATED VARIABLES (CHURCHILL, ET AL, 1976)

| | Sitting Height | Eye Hgt. Sitting | Knee Hgt. Sitting | Butt-Knee Length | Elbow-Grip Length | Thumb-Tip Reach |
|---|---|---|---|---|---|---|
| Weight | .4568 | .4119 | .5386 | .4544 | .4085 | .4138 |
| Bideltoid Brdth. | .2782 | .2598 | .3398 | .4379 | .2514 | .2784 |
| Hip Brdth., Sitting | .3755 | .3457 | .4283 | .5502 | .3432 | .3270 |
| Chest Depth | .3333 | .3078 | .4084 | .5479 | .2882 | .2965 |

TABLE 8

DEPENDENT AND INDEPENDENT VARIABLES (CHURCHILL, ET AL, 1976)

| DEPENDENT VARIABLES | INDEPENDENT VARIABLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Weight | Sitting Height | Eye Height (S) | Knee Height (S) | Buttock-Knee Length | Forearm-Grip Length | Thumb-Tip Reach | Bideltoid Breadth | Hip Breadth (S) | Chest Depth |
| Weight | 1.00 | .4576 | .4130 | .5390 | .6361 | .4080 | .4143 | .7966 | .8549 | .7594 |
| Sitting Height | .4568 | 1.00 | .9302 | .5148 | .3917 | .4613 | .4138 | .2782 | .3333 | .1299 |
| Acromion Height (S) | .4862 | .8126 | .7780 | .4452 | .3382 | .3823 | .3482 | .2676 | .3916 | .2008 |
| Knee Height (S) | .5386 | .5148 | .4876 | 1.00 | .7851 | .7817 | .7002 | .3398 | .4084 | .2853 |
| Buttock-Knee Length | .6363 | .3917 | .3897 | .7851 | 1.00 | .6238 | .6041 | .4379 | .5479 | .4168 |
| Shoulder-Elbow Length | .3995 | .4573 | .4584 | .7500 | .6967 | .6743 | .6752 | .2515 | .2997 | .2092 |
| Biacromial Breadth | .4516 | .3491 | .2964 | .3745 | .2954 | .3481 | .3235 | .6571 | .3202 | .2681 |
| Hip Breadth | .8094 | .3755 | .3457 | .4283 | .5502 | .3432 | .3270 | .6225 | .9031 | .5803 |
| Chest Depth | .7593 | .1299 | .1065 | .2853 | .4168 | .2034 | .2523 | .6240 | .6318 | 1.00 |
| Foot Length | .4711 | .4786 | .4497 | .6919 | .5957 | .6517 | .5545 | .3067 | .3498 | .2445 |
| Hand Length | .3889 | .4506 | .4155 | .6539 | .5432 | .7070 | .5757 | .2553 | .2578 | .2005 |
| Elbow-Wrist Length | .4136 | .4340 | .3699 | .7826 | .6260 | .8994 | .6865 | .2619 | .2993 | .2122 |

the multiple regression coefficients, simple regression coefficients and associated standard error of estimates are available for each of the 28 combinations. Note that the standard units of measurement for all variables used in COMBIMAN are pounds and inches, but there are provisions to change these into metric units.

### 4.3.2 Processing Specification

The Anthropometric Data Base Maintenance program, CBMAM, allows the user to create and maintain the Anthropometric Data Base. The Data Base contains regression data which are used by the interactive graphics program CBM06 to predict anthropometric surface dimensions needed to generate the link system of the man-model. It also contains survey data which define the means, standard deviations, and percentiles for every defined variable for a particular anthropometric survey. Each group of data, whether dealing with regression or survey information, is called an anthropometric member, and is referenced by its member name and type classification.

The program CBMAM allows the user to maintain the Data Base by adding, deleting, listing, etc., the member types through input control cards as shown in Figure 93.

These control cards may be placed in any order in the stream of the program, with one exception. If the Data Base is initialized for the first time, the +INT control card must be the first data card. In the following paragraphs, the control cards format of the function is listed first. This is followed by the text which explains each keyword. Additional data formats, if any, are then described for each function.

| A1 | A4 | | A8 | I4 | I4 | I4 | I4 | I4 | A8 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| + | opr | | member name | type | nvbl | ncmb | ndep | npct | regr name | | Optional Sequence Number |

Figure 93. Program CBMAM Control Card Format.

### 4.3.2.1 ADD ANTHROPOMETRIC MEMBER Function

+ADD membername type nvbl ncmb ndep regrname (followed by member definition)

The ADD ANTHROPOMETRIC MEMBER function, as defined by the +ADD control card and the member definition cards which follow, adds to the Anthropometric Data Base specified data under the name membername. The membername is an alphanumeric character string, whose length is limited to 16 characters. The type field distinguishes between the two types of members. A type value of "0" indicates that the member contains regression information, while a type value of "1" indicates that the member contains survey dimension data. The type value, as well as all other integer values supplied on the control card, must be right-justified within its field. The nvbl field defines the total number of variables described in member membername. The maximum number is 45. The ncmb field indicates the maximum number of combinations of independent mass and length variables. The maximum number is 50. The number of anthropometric variables needed to determine the internal link lengths is supplied in field ndep. The maximum number is 30. Fields, npct and regrname are used only when the type field value is 1. Npct contains the number of percentile values which will be supplied for every one of the nvbl variables. The maximum value for npct is 30. The regrname field refers to the type 0 membername which contains the appropriate regression information.

### 4.3.2.2 TYPE 0 MEMBERS

An example of a +ADD control card for a type 0 member in the 1967 Survey is outlined in Figure 94. The name of the survey member is R67 USAF, and it contains a total of 18 variables, with 28 combinations of independent variables, and 12 combinations of dependent variables. An example of a +ADD control card for a type 1 member is outlined in Figure 95. Note that the values for nvbl, ncmb, and ndep are identical to the type 0 member R67 USAF, shown in Figure 94.

```
+ADD R67 USAF     0   18   28   12  ------>      Ref. Fig. 72
 1 WEIGHT            LB    1         1
 2 SITTING HEIGHT    IN         1    1
 3 EYE HGT/SITTING   IN         1        )
 4 ACROMION HGT/SII  IN              1   )
 5 ARM LENGTH        IN         1        )
 6 THUMB-TIP REACH   IN         1        )   Ref. Fig. 75
 7 SHOULDR-ELB LGTH  IN              1   )
 8 KNEE HGT/SITTING  IN         1    1   )
 9 BUTTOCK-KNE LGTH  IN         1    1   )
10 BIACRCMIAL BRDTH  IN              1
```

Figure 94. Example of +ADD Control Card for Type 0 Member.



```
+ADD 67 USAF      1   18   28   12   25   R67 USAF  ------> Ref. Fig. 72
 1 2 3 5101520253035404550556065707580859095979899 ------> Ref. Fig. 79
 1 WEIGHT              LB 173.60686 21.434704127581326313582140151468915153  )
1552715856161561643716708169741724217513177921808418397187411913219591       ) Ref. Fig. 80
2018321076216622209422773                                                    )
 2 SITTING HEIGHT    IN 36.685932 1.2501624 3394 3424 3444 3470 3511 3539
3562 3582 3600 3617 3633 3649 3665 3681 3698 3715 3733 3753 3775 3801
3833 3880 3910 3931 3962
 3 EYE HGT/SITTING   IN 31.869176 1.1871142 2917 2950 2971 2998 3038 3065
3087 3106 3123 3138 3153 3168 3183 3198 3213 3229 3246 3265 3286 3311
3343 3390 3421 3443 3478
 4 ACROMION HGT/SII  IN 24.03821  1.123410  2142 2177 2197 2224 2263 2289
2310 2327 2343 2358 2373 2387 2401 2415 2430 2445 2461 2479 2499 2522
2551 2594 2620 2639 2666
```

Figure 95. Example of +ADD Control Card for Type 1 Member.

Figures 96, 97, and 98 show the record formats used for type 0 members in the data base. The data provided in the format shown in Figure 96 defined anthropometric variables used in the regression member. Columns 1-2 contain a sequence number for the variable, right-justified in the field. Columns 4-19 contain the 16-character name of the anthropometric variable. Columns 21-22 contain a two-character abbreviation for the default unit of measurement of the variable. Approved abbreviations are IN, CM, MM, LB, and KG for inches, centimeters, millimeters, pounds, and kilograms, respectively. A "1" punched in column 26, 30, or 34, indicates a mass related independent variable, a length related independent variable, or a dependent variable necessary to generate the link lengths respectively. A variable can either be independent or dependent, as in the case of sitting height, but it cannot pertain to both mass and length. If all three fields are blank, the data card is flagged to indicate an error. As each variable definition card is read in, the program checks the use of the variable and rcords its status.

The first outlined area of Figure 99 is an example of a Variable Definition Card. A "1" is punched in columns 30 and 34 to indicate that the Sitting Height is both an independent variable related to body segment length and a dependent variable.

Two types of record formats are used for combinations of mass and length related independent variables as shown in Figures 97 and 98. In Figure 97, the variable numbers, punched in columns 1-3 and 4-6 are obtained from columns 1-2 of the variable definition cards as shown in Figure 96. Columns 11-40 contain simple regression information necessary to predict the length related variable from the mass related variables. This information includes the slope and constant in the regression formula:

$$Y = bX + c \tag{2}$$

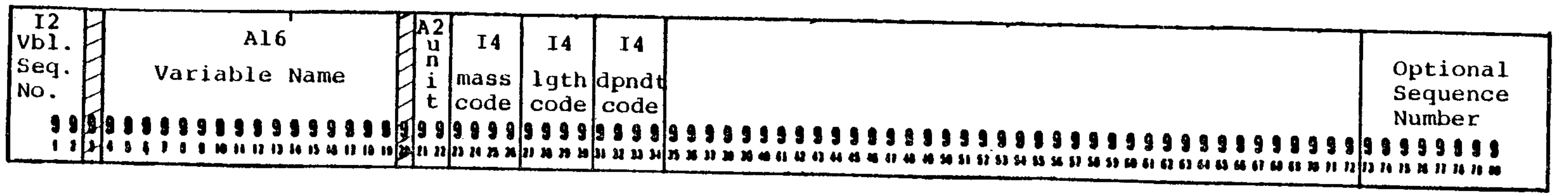



Figure 96. Program CBMAM Regression Member Variable Definition Card.

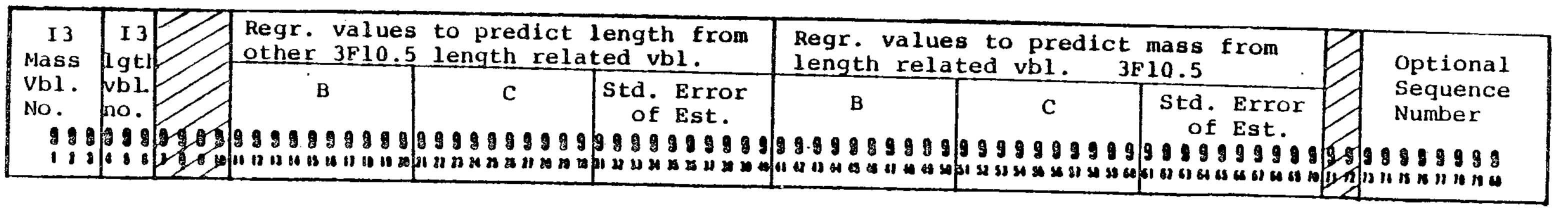



Figure 97. Program CBMAM Regression Member Simple Regression Coefficient Definition Card.

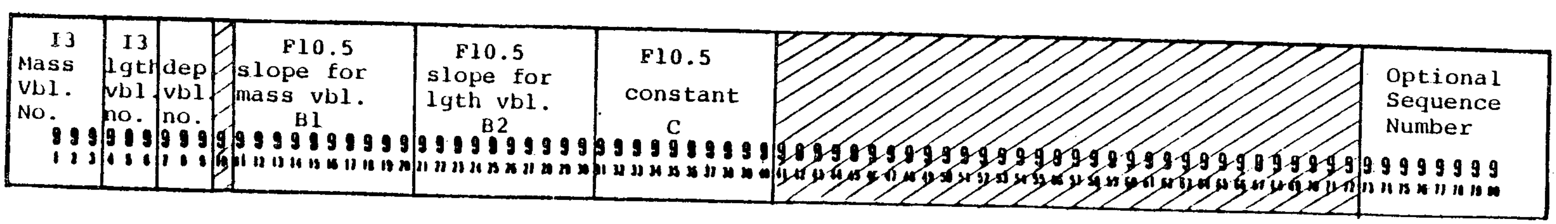



Figure 98. Program CBMAM Regression Member Multiple Regression Coefficient Definition Card.

where

b is the slope and

c is the intercept.

It also contains the standard error of estimate associated with the equation. Columns 41-70 contain similar data to predict mass from the length variable.

The regression data used in the following examples are unpublished data provided by the USAF. These data contain the slope, intercept, and standard error in metric units. The coefficients are multiplied by appropriate factors to convert them to the English units specified on the Variable Definition Card. The regression equation to predict sitting height in inches from weight in pounds is:

$$\underset{\text{(Variable \#2)}}{\text{Estimated Sitting Height}} = 0.02669 \times \underset{\text{(Variable \#1)}}{\text{Actual Weight}} + 32.05275 \tag{1}$$

The standard error is 1.11161.

The equation to predict weight in pounds from sitting height in inches is:

$$\text{Estimated Weight} = 7.84538 \times \text{Actual Sitting Height} - 114.20831 \tag{2}$$

The standard error is 19.05920.

In Figure 99 (2), the "1" in column 3 identifies Weight as the mass related variable, and the "2" in column 6 identifies Sitting Height as the length related variable. The regression coefficients for equations (1) and (2) are punched in the remainder of the card.

The second record format is shown in Figure 98 and contains the multiple regression information necessary to predict each dependent variable from the particular combination of mass and length related variables. Columns 1-3 contain the independent mass variable number; columns 4-6 the independent length variable number; and columns 7-9 the dependent

```
+ADD R67 USAF     0   18   28   12
 1 WEIGHT                LB    1          1
 2 SITTING HEIGHT        IN          1    1                                        (1)
 3 EYE HGT/SITTING       IN          1
 4 ACROMION HGT/SIT      IN               1
 5 ARM LENGTH            IN          1
 6 THUMB-TIP REACH       IN          1
 7 SHOULDR-ELB LGTH      IN               1
 8 KNEE HGT/SITTING      IN          1    1
 9 BUTTOCK-KNE LGTH      IN          1    1
10 BIACROMIAL BRDTH      IN               1
11 BIDELTIOD BRDTH       IN    1
12 HIP BREADTH           IN               1
13 HIP BREADTH/SITT      IN    1
14 CHEST DEPTH           IN    1          1
15 FOOT LENGTH           IN               1
16 HAND LENGTH           IN               1
17 ELBOW-WRIST LGTH      IN               1
18 LEG LENGTH            IN          1
 1  2           0.02669  32.05275   1.11161   7.84538-114.20831  19.05910      (2)
 1  2  1  1.0           0.0         0.0
 1  2  2  0.0           1.0000000   0.0
 1  2  4                .731       -2.779522
 1  2  7                .247        5.090541
 1  2  8                .404        7.133844                                   (3)
 1  2  9                .333       11.566906
 1  2 10  0.0131732 0.1105000       9.69417
 1  2 12  0.0279173 0.0043000       8.87957                                    (4)
 1  2 14  0.0313031-0.1665000      10.32958
 1  2 15  0.0069724 0.1248000       4.85468
 1  2 16                .117        3.232277
 1  2 17                .193        4.728337
 1  3           0.02287  27.89858   1.08116   7.45657 -64.02781  19.52158
 1  3  1  1.0           0.0         0.0
 1  3  2                0.979       5.48424
 1  3  4                0.737       0.55118
```

Figure 99. Example of Regression, or Type 0 Member.

variable number. Each integer value must be right-justified. Columns 11-20 contain the slope associated with the mass variable value ($b_1$); and columns 21-30 the slope for the length variable value ($b_2$); and columns 31-40 the constant of the equation (c). The equation to predict the value y of a dependent variable is of the form:

$$Y = b_1 X_1 + b_2 X_2 + c \qquad (3)$$

where:

$X_1$ is the value of mass related variable and
$X_2$ is the value of length related variable.

The data for this card are derived from the correlation matrices shown in Tables 7 and 8, and from the equations in Zeigen, et al, (1960). Since it is undesirable to have the length related variables to depend on the value chosen for the mass related variable, the multiple regression equations are replaced by single regression equations. As an example, the multiple regression equation to predict Knee Height/Sitting from Weight and Sitting Height is replaced by a single regression equation as follows:

Knee Height/Sitting = 0.00 x Weight (Variable #1)
+ 0.40400 x Sitting Height (Variable #2)
+ 7.133844

The third outlined area of Figure 99 shows the data for this example. A "1" in column 3 identifies Weight as the mass variable; a "2" in column 6 identifies Sitting Height as the length variable; and a "5" in column 9 identifies Knee Height/Sitting as the dependent variable. The regression coefficients are punched in the remainder of the card.

The multiple regression equations are retained for predicting the mass-related variables. As an example, the multiple regression equations to predict Hip Breadth from Weight and Sitting Height is as follows:

$$
\begin{aligned}
\text{Hip Breadth} &= 0.0279173 \times \text{Weight} && \text{(Variable \#1)} \\
&+ 0.0043000 \times \text{Sitting Height} && \text{(Variable \#2)} \\
&+ 8.87957
\end{aligned}
$$

The fourth outlined area of Figure 99 shows the data for this example. A "1" in column 3 identifies Weight as the mass variable; a "2" in column 6 identifies Sitting Height as the length variable; and a "12" in columns 8 and 9 identifies Hip Breadth as the dependent variable. The regression coefficients are punched in the remainder of the card.

If the number of multiple regression coefficient definition data cards is not equal to (ncmb x ndep) the member is not added to the Anthropometric Data Base.

4.3.2.3 TYPE 1 MEMBERS

For type 1 members on the Data Base, the record formats are shown in Figure 100 and 101. The input data in the format shown in Figure 109 defines the percentile names for which values are supplied in succeeding cards. Figure 102 shows the percentile names for the 1967 USAF Survey. The 25 percentile values available for this survey include the 1st, 2nd, 3rd, 5th, and are punched in two-digit integer fields, right-justified within the area. The number of percentiles supplied must be equal to the value in the npct field of the +ADD (type 1) control card, otherwise an error message is printed and the member is not added. Note that the maximum number of percentiles allowed is 30.

Figure 101 shows the format used in assigning dimensional values to the variables. The variable number in integer format is in columns 1-2 while columns 4-19 contain the 16-character variable name. Columns 21-22 contain the two character abbreviation for the default unit of measurement. At present the default or standard unit for weight is pounds, and the standard unit for all other measurements is inches. For each variable number, the variable name and unit of measurement must correspond with the same fields in the reference

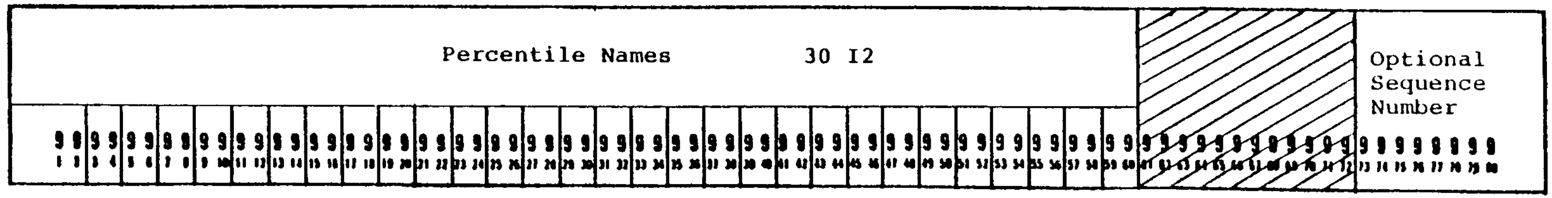



Figure 100. Program CBMAM Survey Member Percentile Definition Card.

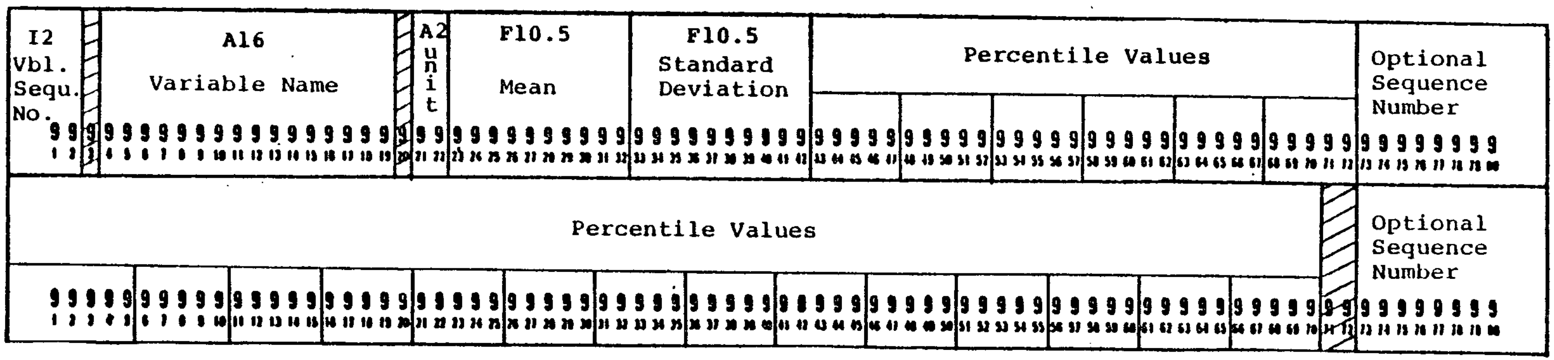



Figure 101. Program CBMAM Survey Member Dimension Definition Cards.

```
+ADD 67 USAF      1   18   28   12   25   R67 USAF        Ref. Fig. 72
 1 2 3 5101520253035404550556065707580859095979899          Ref. Fig. 71
 1 WEIGHT               LB 173.60686 21.434704127581326313582140151468915153
15527156856161561643716708169741724217513177921808418397187411913219591       Ref. Fig. 80
201832107621662220942277 3
 2 SITTING HEIGHT     IN 36.685932 1.2501624 3394 3424 3444 3470 3511 3539
3562 3582 3600 3617 3633 3649 3665 3681 3698 3715 3733 3753 3775 3801
3833 3860 3910 3931 3962
 3 EYE HGT/SITTING  IN 31.869176 1.1871142 2917 2950 2971 2998 3038 3065
3087 3106 3123 3138 3153 3168 3183 3198 3213 3229 3246 3265 3286 3311
3343 3390 3421 3443 3478
 4 ACROMION HGT/SIT IN 24.03821  1.123410  2142 2177 2197 2224 2263 2289
2310 2327 2343 2358 2373 2387 2401 2415 2430 2445 2461 2479 2499 2522
2551 2594 2620 2639 2666
 5 ARM LENGTH         IN 31.07249 1.34508    2802 2837 2859 2890 2937 2969
2995 3017 3037 3056 3073 3091 3108 3125 3142 3160 3179 3199 3223 3250
3284 3335 3369 3394 3434
 6 THUMB-TIP REACH  IN 31.62047  1.56498   2804 2846 2872 2908 2964 3001
3030 3056 3079 3100 3120 3139 3158 3178 3198 3218 3240 3264 3291 3322
3364 3427 3469 3502 3555
 7 SHOULDR-ELB LGTH IN 14.15382   .074011  1265 1281 1291 1306 1329 1345
```

Figure 102. Example of Survey, or Type 1, Member.

type 0 or regression member. Columns 23-32 contain the overall mean for the named variable expressed in the default unit of measurement. Columns 33-42 contain the standard deviation. Columns 43-72 of this data card and columns 1-70 of additional cards necessary to input data contain the values for each of the percentiles named. If the number of percentile values does not correspond to the value of npct, an error condition occurs and the member is not added to the Data Base. The period in the fields in Figures 100 and 101 indicates the standard or default location of the decimal point in real number format.

The dimension data needed in this card are also obtained from the Summary Statistics of the 1967 Survey (Churchill et al, 1976). A sample set of the data for Weight is shown in Figure 92. The mean value of Weight, 173.60686 lbs, the standard deviation, 21.434704, and the weights associated with the first six percentiles, namely the 1st, 2nd, 3rd, 5th, 10th, and 15th are punched on the third card shown in Figure 102. The weight values for the percentiles ranging from 20th to 85th, and from 90th to 99th, are punched in the last card. It is essential that users enter a type 1 member, since the type 1 member references the type 0 member.

#### 4.3.2.4 CHECK ANTHROPOMETRIC MEMBER Function

+CHK membername type nvbl ncmb, ndep npct regr name

The CHECK ANTHROPOMETRIC MEMBER function operates the same way as the +ADD ANTHROPOMETRIC MEMBER function. However, the member is not added but the data are checked for errors.

#### 4.3.2.5 DELETE ANTHROPOMETRIC MEMBER Function

+DEL membername type

The DELETE ANTHROPOMETRIC MEMBER function removes the specified member from the Data Base, but does not make the space occupied by the member available for reuse. The +CMP function must be used to accomplish this.

### 4.3.2.6 COMPRESS ANTHROPOMETRIC DATA BASE Function

+CMP

The COMPRESS ANTHROPOMETRIC DATA BASE function makes space available for storing anthropometric data by compressing used space together and maximizing the amount of continuous unused space on the Data Base. The intermediate blocks of unused space are created by the DELETE ANTHROPOMETRIC MEMBER function. The greater the activity of the Anthropometric Data Base (ie., +ADD's and +DEL's), the more often it becomes necessary to use this +CMP function. If the message "CBM310A INSUFFICIENT SPACE REMAINING TO ADD MEMBER membername" appears while adding a member, it becomes necessary to use the +CMP function. If the +ADD function gives the CBM310 message immediately following the +CMP function, the Data Base is full and no new members can be added until an existing member is deleted from the Data Base.

### 4.3.2.7 DUMP ANTHROPOMETRIC MEMBER Function

+DMP <u>membername</u> <u>type</u>
+DMP

The DUMP ANTHROPOMETRIC MEMBER function prints the contents of the anthropometric member membername of specified type, or prints the complete Anthropometric Data Base if no membername is given on the control card. This function is used primarily by system programmers to check the contents of the file.

### 4.3.2.8 END PROGRAM Function

+END

The END PROGRAM function control card terminates execution of the program CBMAM and returns control to the operating system.

4.3.2.9 INITIALIZE ANTHROPOMETRIC DATA BASE Function

+INT

The INITIALIZE ANTHROPOMETRIC DATA BASE function initializes an Anthropometric Data Base or resets an existing Anthropometric Data Base to its original unused state. All members residing on the Data Base before invoking this function are purged and the entire space is made available for new members. However, the primary purpose of this function is to establish an Anthropometric Data Base.

4.3.2.10 PUNCH ANTHROPOMETRIC MEMBER Function

+PCH membername type

The PUNCH ANTHROPOMETRIC MEMBER function punches a copy of the specified member in the same format as the ADD ANTHROPOMETRIC MEMBER function input data for the specified type onto computer cards. If the user specifies a membername that does not exist on the directory, all the member names on the Data Base directory are printed out. This function does not add or remove any member from the Data Base.

4.3.2.11 PRINT ANTHROPOMETRIC MEMBER Function

+PRT membername type
+PRT

The PRINT ANTHROPOMETRIC MEMBER function prints the contents of the specified member, membername, of type, type, in a format similar to that used in the ADD ANTHROPOMETRIC MEMBER function. If no name is specified, or if a name that is not in the Data Base directory is specified, names of all members in the Data Base directory, the number of records for each member, their types, and any additional data supplied on the +ADD control card when the members were added to the Data Base are printed.

### 4.3.3 Executing CBMAM Program

The set of JCL used at the HESS facility to execute the program CBMAM is shown in Figure 103. Use of the //FT02F001 DD card as shown in Figure 104 assumes that the space for the Data Base has already been allocated and catalogued. If for some reason this condition is not met, the //FT02F001 DD card in Figure 103 should be replaced by the card sequence (3 cards) shown in Figure 104. The job is executed with this replacement series once to allocate space for the dataset (file) on disk, and to catalogue the file. Thereafter the simplified //FT02F001 DD card shown in Figure 103 is used to maintain the Data Base.

If the file has just been created, or if the user wants to reinitialize the file, the +INT control function is used before any other control function. The last control card read into the program should be the +END control card.

### 4.3.4 Output Data Interpretation

The program CBMAM generates output to the card punch, to the disk file, or to the printer depending on the function specified on the control card. The formats for the printed output are discussed in this section. Punched records used the same format as the input data records discussed in Paragraph 4.3.2.

Five basic types of formats are used by CBMAM when data are written on the printer. These format types, their use, and sample outputs are presented in the following paragraphs. Each type begins with the same heading, listing the program name, CBMAM, the date and time of the program execution, and a page number.

The first type of output is generated by the INITIALIZED, PUNCH, COMPRESS, DELETE, and END functions. The output indicates the beginning and end of processing associated with the specified function. For the COMPRESS function, additional messages which indicate that a particular member is or is not moved in the process of compressing used space are printed.

```
//CBMAM     JOB HESS                                              00001000
//JOBLIB    DD DSN=COMBIMAN.LOADLIB,DISP=SHR                      00001100
//CBMAM     EXEC PGM=CBMAM                                        00001200
//FT02F001  DD DSN=COMBIMAN.ANTHDATA,DISP=SHR                     00001300
//FT05F001  DD DDNAME=SYSIN                                       00001400
//FT06F001  DD SYSOUT=A                                           00001500
//FT07F001  DD SYSOUT=B                                           00001600
//SYSUDUMP  DD SYSOUT=A                                           00001700
//SYSIN     DD *                                                  00001800


         CBMAM FUNCTION CONTROL CARDS AND
           MEMBER DEFINITION DATA


/*
//                                                                00001900
```

Figure 103. Job Control Cards to Execute CBMAM.

```
//FT02F001 DD DSN=COMBIMAN.ANTHDATA,UNIT=DISK,DISP=(NEW,CATLG),
//            VOL=SER=DISK01,SPACE=(248,2000),                    00001300
//            DCB=(BLKSIZE=248,LRECL=248,RECFM=FB)                00001310
                                                                  00001320
```

Figure 104. FT02 DD Card to Allocate Space for COMBIMAN.ANTHDTA and Execute CBMVM.

An example of this format for the COMPRESS function is shown in Figure 105.

The second type of output is generated by the PRINT or PUNCH functions when the +PRT or +PCH control cards are supplied with a blank membername field. This causes the program to list the index of the Data Base, which contains the location and type of each member. This information is printed in the following format:

> nn.) membername, EXTENT=(n1, n2), TYPE=tt, nv VARIABLES, nc COMB OF INDEP, and DEPENDENT, np PERCENTILE, r-membername REFERENCED SURVEY.

where:

| | |
|---|---|
| nn | is the record number of its identification record within the directory. |
| n1 | is the location of the first record of the data which defines this member. |
| n2 | is the location of the last record of the data which defines this member. |
| tt | is the type code (0 or 1). |
| nv | is the total number of anthropometric variables defined for the member. |
| nc | is the number of combination of independent variables. |
| nd | is the number of dependent variables. |
| np | is the number of percentiles. Note: np=0 if tt=0. |
| r-membername | is the name of the referenced regression member. Note: r-membername is blank if tt=0. |

This information was originally supplied to the Data Base on the +ADD control card. A sample output of the PRINT function is shown in Figure 106.

```
CBMAM --- ANTHROPOMETRIC SURVEY DATA BASE MAINTENANCE PROGRAM                2/29/80   13.52.36   PAGE  14

CBM300I +CMP R67 USAF
CBM335I R67 USAF WAS IN PLACE.
CBM335I 67 USAF  WAS IN PLACE.
CBM336I COMPRESS FINISHED.
CBM399I PROGRAM END.
```

Figure 105. A Sample Output of the +CMP Function.

```
CBMAM --- ANTHROPOMETRIC SURVEY DATA BASE MAINTENANCE PROGRAM               2/29/80   13.55. 0  PAGE   1

CBM300I +PRT              0
              20.) 67 USAF  , EXTENT=(  63,  80), TYPE= 1, 17 VARIABLES, 24 COMB OF INDEP, 12 DEPENDENT, 25 PERCENTILES,
                              R67 USAF REFERENCED SURVEY.
              21.) R67 USAF, EXTENT=(  22,  62), TYPE= 0, 17 VARIABLES, 24 COMB OF INDEP, 12 DEPENDENT,  0 PERCENTILES,
                                       REFERENCED SURVEY.
```

Figure 106. A Sample Output of the +PRT Function.

The third type of output is generated by the DUMP ANTHROPOMETRIC DATA BASE function. This function is used primarily by systems programmers to locate causes of I/O (Input/Output) errors on the Data Base. For the member specified on the +DMP Control Card, a directory or index information is printed, using the output format previously described for the +PRT control card. Each record associated with the member is then printed in the following format:

```
RECORD nnn + = + (record in EBCDIC)                     + = +
   + = + (record in hexadecimal)                        + = +
   + = + (remainder of record in hexadecimal)           + = +
```

where nnn is the location of the record in the Data Base. The record is printed in EBCDIC using 254A format and in hexadecimal using a 10Z8 format. An example of the DUMP function printout is shown in Figure 107.

The fourth output format is used by the CHECK, ADD, and PRINT functions when a type 0, or regression member is specified. The program CBMAM reads the control card and checks it for errors, and the information obtained from the control card is reformatted and written out to the printer. Following the control card information, each Variable Definition Card is printed. The format used to print the Variable Definition Card is as follows:

nn.) <u>variablename</u>, INDEP VBLS (MASS=<u>ns</u>, LENGTH=<u>ns</u>), DEP VBL=<u>ns</u>, UNIT OF MEASUREMENT=<u>uu</u>

where:

| | |
|---|---|
| nn | is the variable number |
| variablename | is the 16 character name of the variable |
| ns | 0 means NO; 1 means YES |
| uu | is the unit of measurement assigned to the variable: IN, CM, MM, LB, or KG. |

```
RECORD   28+=+   GSHOULDR-ELB LGTH          AIN                                                             +=+
             +=+                                                                                            +=+
             +=+                                              +=+
+=+00000007E2C8D6E4D3C4D960C5D3C240D3C7E3C80000000000000000000000000001C9D54040000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
RECORD   29+=+   HELBOW-GRIP LGTH       A     IN                                                            +=+
             +=+                                                                                            +=+
             +=+                                              +=+
+=+00000008C5D3C2D6E660C7D9C9D740D3C7E3C84000000000000000000001000000000C9D540400000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
RECORD   30+=+   ITHUMB-TIP REACH       A     IN                                                            +=+
             +=+                                                                                            +=+
             +=+                                              +=+
+=+00000009E3C8E4D4C260E3C9D740D9C5C1C3C84000000000000000001000000000C9D540400000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
RECORD   31+=+    BIACROMIAL BRDTH          AIN                                                             +=+
             +=+                                                                                            +=+
             +=+                                              +=+
+=+0000000AC2C9C1C3D9D6D4C9C1D340C2D9C4E3C80000000000000000000000000001C9D54040000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
RECORD   32+=+   .BIDELTIOD BRDTH    A          IN                                                          +=+
             +=+                                                                                            +=+
             +=+                                              +=+
+=+0000000BC2C9C4C5D3E3C9D6C440C2D9C4E3C840000000001000000000000000000000C9D5404000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
RECORD   33+=+   <HIP BREADTH               AIN                                                             +=+
             +=+                                                                                            +=+
             +=+                                              +=+
+=+0000000CC8C9D740C2D9C5C1C4E3C8404040404000000000000000000000000001C9D5404000000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
RECORD   34+=+   (HIP BREADTH/SITT   A          IN                                                          +=+
             +=+                                                                                            +=+
             +=+                                              +=+
+=+0000000DC8C9D740C2D9C5C1C4E3C861E2C9E3E3000000010000000000000000000C9D54040000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
```

Figure 107. A Sample Output of the +DMP Function.

After the variable definition data, the regression data for each combination of independent variables are printed. The format is shown in Figure 108. The terms are defined as follows:

| | |
|---|---|
| n1 | is the variable number for the mass-related variable |
| mass name | is the variable name for the mass-related variable |
| n2 | is the variable number for the length-related variable |
| length name | is the variable name for the length-related variable |
| $bb.bbb_1, bb.bbb_2$ | is the slope used to predict (1) length variable from mass variable, and (2) mass variable from length variable |
| $cc.ccc_1, cc.ccc_2$ | is the constant used to predict (1) length variable from mass variable, and (2) mass variable from length variable |
| $ss.sss_1, ss.sss_2$ | is the standard error of the estimate of the equations |
| $nd_1$ - $nd_{ndep}$ | are the variable numbers for the dependent variables |
| $depname_1$ - $depname_{ndep}$ | are the variable names for the dependent variables |
| $bb.bbbb^1_1$ - $bb.bbbbb^1_{ndep}$ | is the slope for the mass variable when predicting dependent $variable_i$, where i=1, ndep |
| $bb.bbbbb^2_1$ $bb.bbbbb^2_{ndep}$ | is the slope for the length variable when predicting dependent $variable_i$, where i=1,ndep |
| $cc.ccccc_1$ $cc.ccccc_{ndep}$ | is the constant for the multiple regression equation to predict dependent variable $_i$, where i=1, ndep. |

| DEPENDENT VARIABLES (MASS & LENGTH) | DEPENDENT VARIABLE | REGRESSION COEFFICIENTS (B1, B2, CNST) |
|---|---|---|
| n1 mass name    n2 length name | SIMPLE REGR (B1, CNST, SE) - | LENGTH FROM MASS $bb.bbb_1$ $cc.ccc_1$ $ss.sss_1$ |
| | | MASS FROM LENGTH $bb.bbb_2$ $cc.ccc_2$ $ss.sss_2$ |
| | $nd_1$ $\text{dep vbl name}_1$ | $bb.bbbbb_1^1$ $bb.bbbbb_1^2$ $cc.ccccc_1$ |
| | ⋮ ⋮ | ⋮ ⋮ ⋮ |
| | $nd_{ndep}$ $\text{dep vbl name}_{ndep}$ | $bb.bbbbb_{ndep}^1$ $bb.bbbbb_{ndep}^2$ $cc.ccccc_{ndep}$ |

Figure 108. Output Format Used for Type 0 Regression Data.

An example of the output in the fourth format for the +ADD control card is shown in Figures 109 and 110.

The fifth output format is also used by the CHECK, ADD and PRINT functions, but only when the type code is 1, indicating a survey member. The program CBMAM reads the control card and checks it for errors, and reformats and prints the information on the card relevant to the number of records written to the Data Base. Following the control card information, the percentile names (such as 1, 2, 3, 50, 95, etc.) for the member are printed as part of a subheading. A maximum of 10 percentile names are printed on one line. The survey data are then printed in the following format:

$$\text{nn.)}\ \underline{\text{variablename}}\ \underline{\text{uu}}\ \underline{\text{mmm.mm}}\ \underline{\text{ss.sss}}\ \underline{\text{ppp.pp}}_1 \cdots \underline{\text{ppp.pp}}_{10}$$
$$\text{ppp.pp}_{11} \cdots \text{ppp.pp}_{20}$$
$$\text{ppp.pp}_{21} \cdots \text{ppp.pp}_{npct}$$

where

| | |
|---|---|
| nn | is the variable number |
| variablename | is the name of the anthropometric variable |
| uu | is the specified unit of measurement for the variable |
| mmm.mm | is the mean value for the variable |
| ss.sss | is the standard deviation for the variable |
| $\text{ppp.pp}_1$ - $\text{ppp.pp}_{npct}$ | are the percentile values associated with the percenitle names for the anthropometric variables |

An example of this fifth format is shown in Figure 111.

```
CBMAM --- ANTHROPOMETRIC SURVEY DATA BASE MAINTENANCE PROGRAM              7/11/83  10.36.15  PAGE   2

CBM300I +ADD R67 USAF    C  18   28   12     0
CBM313I MEMBER R67 USAF  IS TYPE 0 AND CONTAINS 18 ANTHROPOMETRIC VARIABLE NAMES.
CBM314I MEMBER ALSO CONTAINS 28 ADDITIONAL RECORDS, EACH CONTAINING THE REGRESSION COEFFICIENTS FOR 12 DEPENDENT VARIABLES.
                 1.) WEIGHT            , INDEP VBLS(MASS= 1, LENGTH= 0), DEP VBL= 1, JNIT OF MEASUREMENT= LB
                 2.) SITTING HEIGHT    , INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 1, JNIT OF MEASUREMENT= IN
                 3.) EYE HGT/SITTING   , INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 0, JNIT OF MEASUREMENT= IN
                 4.) ACROMION HGT/SIT, INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, JNIT OF MEASUREMENT= IN
                 5.) ARM LENGTH        , INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 0, JNIT OF MEASUREMENT= IN
                 6.) THUMB-TIP REACH   , INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 0, JNIT OF MEASUREMENT= IN
                 7.) SHOULDR-ELB LGTH, INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, JNIT OF MEASUREMENT= IN
                 8.) KNEE HGT/SITTING, INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 1, JNIT OF MEASUREMENT= IN
                 9.) BUTTOCK-KNE LGTH, INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 1, JNIT OF MEASUREMENT= IN
                10.) BIACROMIAL BRDTH, INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, JNIT OF MEASUREMENT= IN
                11.) BIDELTIOD BRDTH , INDEP VBLS(MASS= 1, LENGTH= 0), DEP VBL= 0, JNIT OF MEASUREMENT= IN
                12.) HIP BREADTH       , INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, JNIT OF MEASUREMENT= IN
                13.) HIP BREADTH/SITT, INDEP VBLS(MASS= 1, LENGTH= 0), DEP VBL= 0, JNIT OF MEASUREMENT= IN
                14.) CHEST DEPTH       , INDEP VBLS(MASS= 1, LENGTH= 0), DEP VBL= 1, JNIT OF MEASUREMENT= IN
                15.) FOOT LENGTH       , INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, JNIT OF MEASUREMENT= IN
                16.) HAND LENGTH       , INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, JNIT OF MEASUREMENT= IN
                17.) ELBOW-WRIST LGTH, INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, JNIT OF MEASUREMENT= IN
                18.) LEG LENGTH        , INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 0, JNIT OF MEASUREMENT= IN

                INDEPENDENT VARIABLES (MASS & LENGTH)     DEPENDENT VARIABLE     REGRESSION COEFFICIENTS (B1, B2, CNST)

                 1 WEIGHT                2 SITTING HEIGHT   SIMPLE REGR (B1,CNST,SE) - LENGTH FROM MASS      0.027  32.053    1.112
                                                                                MASS         LENGTH    7.845-114.208   19.059
                                                       1 WEIGHT            1.00000    0.0        0.0
                                                       2 SITTING HEIGHT    0.0        1.00000    0.0
                                                       4 ACROMION HGT/SIT  0.0        0.73100   -2.77952
                                                       7 SHOULDR-ELB LGTH  0.0        0.24700    5.09054
                                                       8 KNEE HGT/SITTING  0.0        0.40400    7.13384
                                                       9 BUTTOCK-KNE LGTH  0.0        0.33300   11.56690
                                                      10 BIACROMIAL BRDTH  0.01317    0.11050    9.69417
                                                      12 HIP BREADTH       0.02792    0.00430    8.87957
                                                      14 CHEST DEPTH       0.03130   -0.16650   10.32958
                                                      15 FOOT LENGTH       0.00697    0.12480    4.85468
                                                      16 HAND LENGTH       0.0        0.11700    3.23228
                                                      17 ELBOW-WRIST LGTH  0.0        0.19300    4.72834
```

Figure 109.  A Sample Output of the +ADD Function for TYPE 1 Member.

```
CBMAM --- ANTHROPOMETRIC SURVEY DATA BASE MAINTENANCE PROGRAM                    7/11/83  10.36.15  PAGE  3

1 WEIGHT        3 EYE HGT/SITTING   SIMPLE REGR (B1,CNST,SE) - LENGTH FROM MASS      0.023  27.899   1.081
                                                         MASS         LENGTH      7.457 -64.028  19.522
                                     1 WEIGHT            1.00000   0.0        0.0
                                     2 SITTING HEIGHT    0.0       0.97900    5.48424
                                     4 ACROMION HGT/SIT  0.0       0.73700    0.55118
                                     7 SHOULDR-ELB LGTH  0.0       0.26000    5.86613
                                     8 KNEE HGT/SITTING  0.0       0.40300    9.11415
                                     9 BUTTOCK-KNE LGTH  0.0       0.34900   12.66139
                                    10 BIACROMIAL BRDTH  0.01416   0.08570   10.84526
                                    12 HIP BREADTH       0.02782   0.00930    8.75802
                                    14 CHEST DEPTH       0.03049  -0.15870    9.41976
                                    15 FOOT LENGTH       0.00752   0.12150    5.46532
                                    16 HAND LENGTH       0.0       0.11300    3.92125
                                    17 ELBOW-WRIST LGTH  0.0       0.17300    6.29526
1 WEIGHT        5 ARM LENGTH        SIMPLE REGR (B1,CNST,SE) - LENGTH FROM MASS      0.028  26.155   1.200
                                                         MASS         LENGTH      7.197 -50.027  19.134
                                     1 WEIGHT            1.00000   0.0        0.0
                                     2 SITTING HEIGHT    0.0       0.44707   22.78517
                                     4 ACROMION HGT/SIT  0.0       0.35904   12.87857
                                     7 SHOULDR-ELB LGTH  0.0       0.43726    0.56455
                                     8 KNEE HGT/SITTING  0.0       0.60757    3.07370
                                     9 BUTTOCK-KNE LGTH  0.0       0.57349    5.95935
                                    10 BIACROMIAL BRDTH  0.01350   0.09244   10.81827
                                    12 HIP BREADTH       0.02794   0.00304    8.93795
                                    14 CHEST DEPTH       0.02896  -0.07272    6.88447
                                    15 FOOT LENGTH       0.0       0.23926    3.20737
                                    16 HAND LENGTH       0.0       0.18333    1.82567
                                    17 ELBOW-WRIST LGTH  0.0       0.34779    1.00030
1 WEIGHT        6 THUMB-TIP REACH   SIMPLE REGR (B1,CNST,SE) - LENGTH FROM MASS      0.030  26.358   1.426
                                                         MASS         LENGTH      5.668  -5.585  19.508
                                     1 WEIGHT            1.00000   0.0        0.0
                                     2 SITTING HEIGHT    0.0       0.33000   26.25191
                                     4 ACROMION HGT/SIT  0.0       0.25000   16.13382
                                     7 SHOULDR-ELB LGTH  0.0       0.29100    4.95275
                                     8 KNEE HGT/SITTING  0.0       0.43900    8.07479
                                     9 BUTTOCK-KNE LGTH  0.0       0.41000   10.81887
                                    10 BIACROMIAL BRDTH  0.01368   0.08050   11.11438
                                    12 HIP BREADTH       0.02817  -0.00460    9.13904
                                    14 CHEST DEPTH       0.02796  -0.03620    5.94550
                                    15 FOOT LENGTH       0.00637   0.12980    5.43332
                                    16 HAND LENGTH       0.0       0.11900    3.75984
                                    17 ELBOW-WRIST LGTH  0.0       0.24300    4.12598
```

Figure 110. A Sample Output of the +ADD Function for TYPE 1 Member.

CBMAM --- ANTHROPOMETRIC SURVEY DATA BASE MAINTENANCE PROGRAM 7/11/83 10.36.15 PAGE 13

CBM3001 +ADD 67 USAF 1 18 28 12 25 R67 USAF
CBM3131 MEMBER 67 USAF IS TYPE 1 AND CONTAINS 18 ANTHROPOMETRIC VARIABLE NAMES.

| NO. | VARIABLE NAME | UNIT | MEAN | STDV | PERCENTILES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1 | 2 | 3 | 5 | 10 | 15 | 20 | 25 | 30 | 35 |
| | | | | | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 |
| | | | | | 90 | 95 | 97 | 98 | 99 | | | | | |
| 1.) | WEIGHT | LB | 173.61 | 21.435 | 127.58 | 132.63 | 135.82 | 140.15 | 146.89 | 151.53 | 155.27 | 158.56 | 161.56 | 164.37 |
| | | | | | 167.08 | 169.74 | 172.42 | 175.13 | 177.92 | 180.84 | 183.97 | 187.41 | 191.32 | 195.91 |
| | | | | | 201.83 | 210.76 | 216.62 | 220.94 | 227.73 | | | | | |
| 2.) | SITTING HEIGHT | IN | 36.69 | 1.250 | 33.94 | 34.24 | 34.44 | 34.70 | 35.11 | 35.39 | 35.62 | 35.82 | 36.00 | 36.17 |
| | | | | | 36.33 | 36.49 | 36.65 | 36.81 | 36.98 | 37.15 | 37.33 | 37.53 | 37.75 | 38.01 |
| | | | | | 38.33 | 38.80 | 39.10 | 39.31 | 39.62 | | | | | |
| 3.) | EYE HGT/SITTING | IN | 31.87 | 1.187 | 29.17 | 29.50 | 29.71 | 29.98 | 30.38 | 30.65 | 30.87 | 31.06 | 31.23 | 31.38 |
| | | | | | 31.53 | 31.68 | 31.83 | 31.98 | 32.13 | 32.29 | 32.46 | 32.65 | 32.86 | 33.11 |
| | | | | | 33.43 | 33.90 | 34.21 | 34.43 | 34.78 | | | | | |
| 4.) | ACROMION HGT/SIT | IN | 24.04 | 1.123 | 21.42 | 21.77 | 21.97 | 22.24 | 22.63 | 22.89 | 23.10 | 23.27 | 23.43 | 23.58 |
| | | | | | 23.73 | 23.87 | 24.01 | 24.15 | 24.30 | 24.45 | 24.61 | 24.79 | 24.99 | 25.22 |
| | | | | | 25.51 | 25.94 | 26.20 | 26.39 | 26.66 | | | | | |
| 5.) | ARM LENGTH | IN | 31.07 | 1.345 | 28.02 | 28.37 | 28.59 | 28.90 | 29.37 | 29.69 | 29.95 | 30.17 | 30.37 | 30.56 |
| | | | | | 30.73 | 30.91 | 31.08 | 31.25 | 31.42 | 31.60 | 31.79 | 31.99 | 32.23 | 32.50 |
| | | | | | 32.84 | 33.35 | 33.69 | 33.94 | 34.34 | | | | | |
| 6.) | THUMB-TIP REACH | IN | 31.62 | 1.565 | 28.04 | 28.46 | 28.72 | 29.08 | 29.64 | 30.01 | 30.30 | 30.56 | 30.79 | 31.00 |
| | | | | | 31.20 | 31.39 | 31.58 | 31.78 | 31.98 | 32.18 | 32.40 | 32.64 | 32.91 | 33.22 |
| | | | | | 33.64 | 34.27 | 34.69 | 35.02 | 35.55 | | | | | |
| 7.) | SHOULDER-ELB LGTH | IN | 14.15 | 0.674 | 12.65 | 12.81 | 12.91 | 13.06 | 13.29 | 13.45 | 13.57 | 13.68 | 13.79 | 13.88 |
| | | | | | 13.97 | 14.06 | 14.14 | 14.23 | 14.32 | 14.41 | 14.51 | 14.61 | 14.73 | 14.86 |
| | | | | | 15.03 | 15.28 | 15.44 | 15.55 | 15.73 | | | | | |
| 8.) | KNEE HGT/SITTING | IN | 21.96 | 0.980 | 19.73 | 19.98 | 20.15 | 20.37 | 20.71 | 20.95 | 21.13 | 21.29 | 21.43 | 21.57 |
| | | | | | 21.69 | 21.82 | 21.94 | 22.06 | 22.19 | 22.31 | 22.45 | 22.60 | 22.77 | 22.96 |
| | | | | | 23.22 | 23.60 | 23.86 | 24.05 | 24.36 | | | | | |
| 9.) | BUTTOCK-KNE LGTH | IN | 23.78 | 1.062 | 21.38 | 21.65 | 21.83 | 22.07 | 22.44 | 22.69 | 22.89 | 23.06 | 23.22 | 23.36 |
| | | | | | 23.50 | 23.63 | 23.76 | 23.89 | 24.02 | 24.16 | 24.31 | 24.47 | 24.65 | 24.86 |
| | | | | | 25.14 | 25.57 | 25.87 | 26.10 | 26.48 | | | | | |
| 10.) | BIACROMIAL BRDTH | IN | 16.03 | 0.764 | 14.18 | 14.41 | 14.56 | 14.75 | 15.05 | 15.25 | 15.41 | 15.54 | 15.66 | 15.76 |
| | | | | | 15.86 | 15.96 | 16.05 | 16.14 | 16.24 | 16.33 | 16.43 | 16.54 | 16.66 | 16.80 |
| | | | | | 16.98 | 17.26 | 17.44 | 17.58 | 17.82 | | | | | |
| 11.) | BIDELTIOD BRDTH | IN | 18.99 | 1.008 | 16.67 | 16.96 | 17.14 | 17.37 | 17.72 | 17.95 | 18.14 | 18.30 | 18.44 | 18.58 |
| | | | | | 18.71 | 18.84 | 18.96 | 19.09 | 19.22 | 19.36 | 19.51 | 19.67 | 19.85 | 20.05 |
| | | | | | 20.32 | 20.71 | 20.97 | 21.15 | 21.42 | | | | | |
| 12.) | HIP BREADTH | IN | 13.88 | 0.742 | 12.21 | 12.41 | 12.54 | 12.71 | 12.97 | 13.14 | 13.28 | 13.39 | 13.50 | 13.59 |
| | | | | | 13.68 | 13.77 | 13.86 | 13.95 | 14.04 | 14.13 | 14.23 | 14.34 | 14.47 | 14.62 |
| | | | | | 14.82 | 15.15 | 15.37 | 15.55 | 15.84 | | | | | |
| 13.) | HIP BREADTH/SITT | IN | 14.88 | 0.906 | 12.86 | 13.10 | 13.25 | 13.45 | 13.75 | 13.96 | 14.12 | 14.26 | 14.39 | 14.51 |
| | | | | | 14.62 | 14.73 | 14.84 | 14.95 | 15.06 | 15.18 | 15.31 | 15.45 | 15.61 | 15.80 |
| | | | | | 16.05 | 16.44 | 16.70 | 16.90 | 17.23 | | | | | |
| 14.) | CHEST DEPTH | IN | 9.65 | 0.758 | 7.98 | 8.14 | 8.25 | 8.41 | 8.67 | 8.85 | 9.00 | 9.13 | 9.25 | 9.36 |
| | | | | | 9.46 | 9.56 | 9.65 | 9.75 | 9.85 | 9.94 | 10.05 | 10.16 | 10.29 | 10.43 |
| | | | | | 10.62 | 10.90 | 11.10 | 11.24 | 11.49 | | | | | |
| 15.) | FOOT LENGTH | IN | 10.64 | 0.468 | 9.57 | 9.70 | 9.79 | 9.89 | 10.06 | 10.17 | 10.25 | 10.33 | 10.39 | 10.46 |
| | | | | | 10.52 | 10.57 | 10.63 | 10.69 | 10.75 | 10.81 | 10.88 | 10.95 | 11.03 | 11.13 |
| | | | | | 11.25 | 11.44 | 11.56 | 11.65 | 11.80 | | | | | |

Figure 111. A Sample Output of the +ADD Function for TYPE 0 Member.

## 4.4 PROGRAM MESSAGES INCLUDING ERROR CORRECTION

The program CBMAM prints out both information and action related messages. The message format is as follows:

| | |
|---|---|
| CBM3nni | message text |

where:

| | |
|---|---|
| nn | is the message number |
| i | identifies the action code (I=Informational, A=Action to be performed), and |
| message text | is the text of the message. |

Unless otherwise noted, all messages are issued by the routine CBMAM.

CBM300I <u>Control card image</u> (e.g. +ADD, +PRT, etc.).

| | |
|---|---|
| Reason: | The user submitted a control card. |
| System Action: | Continues processing. |
| User Action: | None. |

CBM301A <u>Operation</u> - UNKNOWN OPERATION.

| | |
|---|---|
| Reason: | The operation on the control card (shown in the previous CBM300I Message) is unknown. |
| System Action: | The control card is ignored. |
| User Action: | Correct card, using a valid operation, and resubmit. |

CBM302I INITIALIZED.

| | |
|---|---|
| Reason: | The user requested to initialize the Anthropometric Data Base using the INITIALIZE ANTHROPOMETRIC DATA BASE Function(+INT). |
| System Action: | The Data Base is initialized. |
| User Action: | None. |

CBM303A NO NAME GIVEN; <u>operation</u> IGNORED.

| | |
|---|---|
| Reason: | The operation specified on the control card requires a membername; but no name was supplied. |
| System Action: | The control card and subsequent data, if any, are ignored. |
| User Action: | Correct the card, adding the appropriate additional information as required in the definition of the specific operation and resubmit. |

CBM304A TYPE SPECIFICATION INVALID FOR MEMBER <u>membername.</u>

| | |
|---|---|
| Reason: | An invalid type code, that is, a type code other than 0 or 1, was given for the specified member. |
| System Action: | Control card, and any subsequent data, are ignored. |
| User Action: | Correct code and resubmit. |

CBM305A NUMBER OF ANTHROPOMETRIC DIMENSIONS INVALID FOR MEMBER <u>membername.</u>

| | |
|---|---|
| Reason: | The number of anthropometric dimensions specified for the given member on either the +ADD or +CHK control card was either less than one or greater than 45. |
| System Action: | Control card and any subsequent data are ignored. |
| User Action: | Correct value and resubmit. |

CBM306A NUMBER OF COMBINATIONS OF INDEPENDENT VARIABLES INVALID FOR MEMBER <u>membername</u>.

| | |
|---|---|
| Reason: | The number of combinations of independent variables (the product of the number of mass related variables and the number of length related variables) for the +ADD or +CHK control card is less than one or greater than 50, for the specified member. |
| System Action: | The control card and any subsequent data are ignored. |
| User Action: | Correct the card and resubmit. |

CBM307A NUMBER OF DEPENDENT VARIABLES INVALID FOR MEMBER membername.

Reason: The number of dependent variables specified on the +ADD or +CHK control card was less than one or greater than 30 for the indicated member.

System Action: The control card and any subsequent data are ignored.

User Action: Correct the card and resubmit.

CBM308A NUMBER OF PERCENTILES INVALID FOR MEMBER membername.

Reason: The number of percentiles specified on the +ADD or +CHK control card was less than one or greater than 30 for the indicated member.

System Action: The control card and subsequent data are ignored.

User Action: Correct the number and resubmit.

CBM309A ILLEGAL CONTROL CARD FOR MEMBER membername DUE TO nn ERRORS.

Reason: Control card format invalid. The system found nn errors.

System Action: Control card and subsequent data cards are ignored.

User Action: Correct the card and resubmit.

CBM310A INSUFFICIENT SPACE REMAINING TO ADD MEMBER membername.

Reason: The Data Base does not have sufficient continuous space to add the specified member.

System Action: The member is not added to the data base.

User Action: Run the program CBMAM with the +CMP control card, followed by the request to add the specified member. If the CBM310A message reappears, members will have to be deleted (using the +DEL function) before adding new member.

CBM311A DIRECTORY IS FULL, CANNOT ADD membername.

| | |
|---|---|
| Reason: | The Data Base directory, which contains the location of each member within the file, can hold a maximum of 20 entries. |
| System Action: | The member is not added to the Data Base. |
| User Action: | Delete a member and add the new member. |

CBM312A MEMBER membername IS NOT FOUND IN THE DIRECTORY.

| | |
|---|---|
| Reason: | The type 0 member membername which was referenced by the type 1 member is not in the directory. |
| System Action: | The control card and data are ignored. |
| User Action: | Check that the type 0 member was specified. |

CBM313I MEMBER, membername IS TYPE tt AND CONTAINS nn ANTHROPOMETRIC VARIABLE NAMES.

| | |
|---|---|
| Reason: | The +ADD or +CHK control card has been read in for the specified member, and the type field and the number of variables have been accepted. |
| System Action: | Program continues execution. |
| User Action: | None. |

CBM314I MEMBER ALSO CONTAINS nn ADDITIONAL RECORDS, ECH CONTAINING THE REGRESSION COEFFICIENTS FOR mm DEPENDENT VARIABLES.

| | |
|---|---|
| Reason: | Message is printed for +ADD or +CHK control card for type 0 members. It provides information on the number of additional records associated with the previously specified member. |
| System Action: | Program continues execution. |
| User Action: | None. |

CBM315A VARIABLE variablename1 HAS THE SAME NUMBER AS VARIABLE variablename2.

| | |
|---|---|
| Reason: | Each variable entered as part of a type 0 or type 1 member must have a unique number. |
| System Action: | Record which defines variablename1 is flagged as containing an error. Member is not added. |
| User Action: | Correct the number and resubmit. |

CBM316A variable name USED IN VARIABLES n1 AND n2.

Reason: Each variable number must have a unique variable name.

System Action: Record which contains variable number n2 is flagged as containing an error. Member is not added.

User Action: Correct record and resubmit.

CBM317A variable name IS NEITHER DEPENDENT OR INDEPENDENT

Reason: An anthropometric variable must be defined as either dependent, that is one necessary for the creation of the link system of the model, or independent, that is a variable highly correlated to body segment length. This variable has not been flagged as either.

System Action: The record is flagged as containing an error, and the member is not added to the data base.

User Action: Punch a "1" in either column 16, 30, or 34, depending on the type of variable and resubmit.

CBM318A variablename IS INDEPENDENT VARIABLE FOR BOTH MASS AND LENGTH.

Reason: An anthropometric variable may be an independent variable correlated to either mass or length, but not to both.

System Action: The record is flagged as containing an error, and the member is not added to the Data Base.

User Action: Delete the entry "1" from either column 26 or 30 and resubmit.

CBM319A MEMBER membername CONTAINS TOO MANY INDEPENDENT VARIABLES.

Reason: The number of combinations of independent variables (number of mass variables x number of length variables) encountered must be equal to the number of combinations specified on the +ADD or +CHK control card.

System Action: Member is not added to Data Base.

User Action: Verify the totals, make the appropriate corrections, and resubmit.

CBM320A MEMBER membername CONTAINS TOO MANY DEPENDENT VARIABLES.

Reason: The number of dependent variables encountered must be equal to the number of dependent variables specified on the +ADD or +CHK control card.

System Action: Member is not added to the Data Base.

User Action: Verify the total, make appropriate corrections, and resubmit.

CBM321A UNIT OF MEASUREMENT, uu FOR VARIABLE variablename IS NOT PERMISSIBLE.

Reason: Valid units of measurement are IN, CM, MM, LB, and KG.

System Action: The record is flagged and the member is not added to the Data Base.

User Action: Supply a valid unit of measurement, and resubmit.

CBM322A DATA CARD IMAGE multiple regression coefficient card image OUT OF SEQUENCE.

Reason: For each combination of independent variables, a total of NDEP+1 records must be supplied, each beginning with the same two variable numbers specifying the mass and length variable.

System Action: The record is flagged and the member is not added to the Data Base.

User Action: Correct the error and resubmit.

CBM323A VARIABLE variable name IS NOT AN INDEPENDENT VARIABLE PERTAINING TO MASS.

Reason: The variable number supplied in column 1-3 of the regression data cards should correspond to a variable name defined as a mass related independent variable on one of the anthropometric variable definition cards. (See Figure 80)

System Action: The record is flagged and the member is not added to the Data Base.

User Action: Correct the error and resubmit.

CBM324A VARIABLE variablename IS NOT AN INDEPENDENT VARIABLE PERTAINING TO LENGTH.

Reason: The variable number supplied in column 4-6 of the regression definition data cards should correspond to a variable name defined as a length related independent variable on one of the anthropometric variable definition cards. (See Figure 80)

System Action: The record is flagged and the member is not added to the Data Base.

User Action: Correct the error and resubmit.

CBM325A VARIABLE variablename IS NOT A DEPENDENT VARIABLE.

Reason: The variable number supplied in columns 7-9 of the multiple regression data definition cards should correspond to a variable name defined as a dependent variable on one of the anthropometric variable definition cards. (See Figure 80)

System Action: The record is flagged and the member is not added to the Data Base.

User Action: Correct the error and resubmit.

CBM326A VARIABLE nn OUT OF SEQUENCE.

Reason: For a type 1 member definition, the survey definition cards must contain the variable numbers in ascending order.

System Action: The record is flagged and the member is not added to the Data Base.

User Action: Make necessary corrections and resubmit.

CBM327A variablename IN MEMBER survey membername DOES NOT CORRESPOND TO VARIABLE nn IN regression membername.

Reason: The variable names and numbers in the type 1 member survey membername should correspond exactly to the names and numbers in the referenced type 0 member regression membername.

System Action: The record in the type 1 member definition is flagged and the member is not added to the Data Base.

User Action: Verify the survey definition variable number and name against the regression or type 0 member, make necessary corrections, and resubmit.

CBM328A ANTHROPOMETRIC DIMENSION LT OR EQ TO ZERO.

| | |
|---|---|
| Reason: | Dimensions supplied in the survey member definition cards must be positive real numbers. |
| System Action: | The record is flagged and the member is not added. |
| User Action: | Correct and resubmit. |

CBM329I MEMBER <u>regression membername</u>, WITH <u>nn</u> ANTHROPOMETRIC VARIABLES AND $\underline{nn}_1$ X $\underline{nn}_2$ SETS OF REGRESSION EQUATION, HAS BEEN ADDED.

| | |
|---|---|
| Reason: | The type 0 member is added to the Data Base. |
| System Action: | The member is added to the Data Base. |
| User Action: | None. |

CBM330I MEMBER <u>survey membername</u>, WITH <u>nn</u> ANTHROPOMETRIC VARIABLES AND $\underline{nn}_1$ PERCENTILES, AND REFERENCING SURVEY <u>regression membername</u> HAS BEEN ADDED.

| | |
|---|---|
| Reason: | The type 1 member is added to the Data Base. |
| System Action: | The member is added to the Data Base. |
| User Action: | None. |

CBM331A <u>membername</u> HAS NOT BEEN ADDED DUE TO <u>nnn</u> ERRORS.

| | |
|---|---|
| Reason: | After checking the member definition, nnn syntax errors were found. |
| System Action: | The member is not added to the Data Base. |
| User Action: | correct the errors, and resubmit. |

CBM332A MEMBER <u>membername</u> CHECKED - <u>nnnnn</u> ERRORS.

| | |
|---|---|
| Reason: | After checking the member definition, nnnnn syntax errors were found. |
| System Action: | None. |
| User Action: | Correct the errors and resubmit. |

CBM333I MEMBER <u>membername</u> DELETED.

| | |
|---|---|
| Reason: | User requested +DEL function caused a member to be deleted from the Data Base. |
| System Action: | Member deleted from Data Base. |
| User Action: | None. |

CBM334I membername NOW IN PLACE.

Reason: User requested +CMP function caused member to be moved within Data Base, combining unused space.

System Action: Directory index in Data Base updated.

User Action: None.

CBM335I membername WAS IN PLACE.

Reason: User requested +CMP function and the system found that the member membername need not be moved.

System Action: Compression of Data Base continues.

User Action: None.

CBM336I COMPRESS FINISHED.

Reason: Successful completion of +CMP function.

System Action: Program execution continues.

User Action: None.

CBM337I membername PUNCHED.

Reason: User initiated +PCH function for member membername successfully completed.

System Action: Punching is completed.

User Action: None.

CBM339A END-OF-DATA.

Reason: End of file found before END Program Control Card (+END) was found.

System Action: Terminates job.

User Action: Use a name and resubmit.

CBM340A MEMBER membername ALREADY EXISTS.

Reason: The user has tried to add an anthropometric member definition under a name that already exists in the Data Base.

System Action: The control card is ignored.

User Action: Use a new name and resubmit.

CBM341A DATABASE IS NOT AN ANTHROPOMETRIC DATA BASE.

| | |
|---|---|
| Reason: | First record of file does not contain "ANTH", the Anthropometric Data Base identification word. |
| System Action: | Terminates the program. |
| User Action: | Contact systems programmer. |

CBM342A I/O ERROR ON RECORD nnnnn (INDEX).

| | |
|---|---|
| Reason: | An I/O error has occurred in the directory of the Anthropometric Data Base. |
| System Action: | Terminates the program. |
| User Action: | Contact systems programmer. |

CBM343A I/O ERROR ON RECORD nnnnn (DATA).

| | |
|---|---|
| Reason: | An I/O error has occurred in a member definition on the Anthropometric Data Base. |
| System Action: | Terminates the program. |
| User Action: | Contact systems programmer. |

CBM399I PROGRAM END.

| | |
|---|---|
| Reason: | The +END Control Card was encountered, or the end of input cards was encountered, or there was an I/O error. |
| System Action: | Terminates the program. |
| User Action: | Check that all control cards were accepted, and processed correctly. |

SECTION 5

# COMBIMAN CREW STATION DATA BASE MAINTENANCE PROGRAM (CBMCM)

Before the user can analyze a crew station, that crew station must be digitized and read into a COMBIMAN compatible data base by means of the supplied utility programs called CBMCM or CBMCM2. The difference between these two utilities is given in Paragraph 5.1. The data flow for the program CBMCM is shown in Figure 112. CBMCM2 is the newer and more cpable method and is recommended to the user for all new crew station development. CBMCM is now obsolete, but is retained to allow users to continue to maintain their old data bases created under Version 5 and previous.

The Crew Station Data Base contains definitions which describe the crew stations geometrically. Typical crew stations are aircraft cockpits, driver's area of an automobile, etc. To define a crew station, the user must supply the definition and 3-D coordinates of the vertices of the "panels" which make up the crew stations and controls found on and about the defined panels. Each crew station in the Data Base is called a "member", and is referenced by its membername.

## 5.1 PROCESSING CAPABILITIES

The program CBMCM allows the user to create and maintain the Crew Station Data Base. Input supplied by the user, on 80 character computer cards or in card image format (80 character records) on a magnetic tape or any other device, is read into the program CBMCM and is processed according to the control card commands selected by the user. These commands allow the user to add or delete members, to print or punch existing members, or to list the contents of the Data Base and its directory. The program is also used to compress the members within the Data Base.

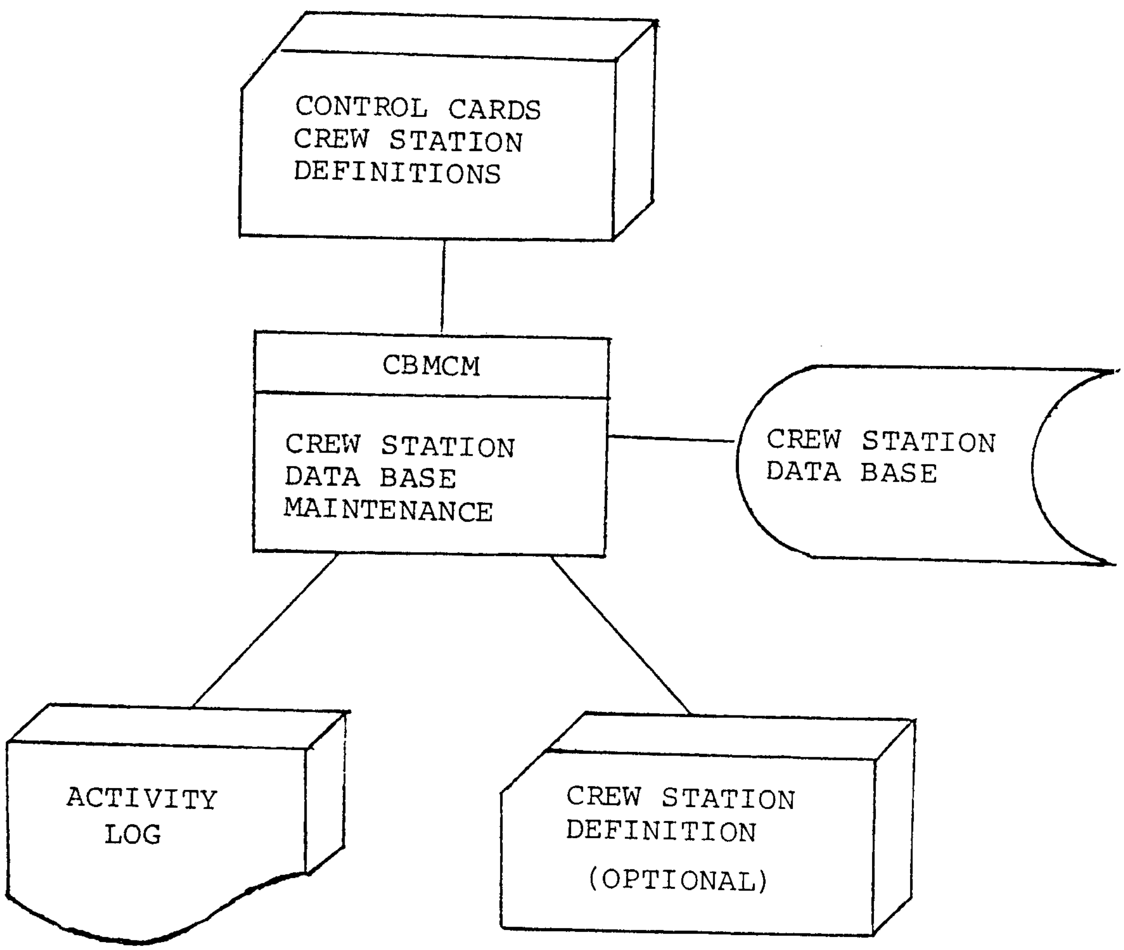



Figure 112. Data Flow for Program CBMCM.

The control cards for CBMCM may be input in any order with one exception. If the Data Base is created for the first time, or if it is reinitialized, the $INT (Initialize) control card must precede all other control cards and member definitions.

The difference between CBMCM and CBMCM2 are as follows:

(a) For CBMCM panels have to be closed and must have vertices three to six (Also see Figure 115). For CBMCM2 panels can be closed or opened and must have vertices one to twenty-five.

(b) For CBMCM to add a panel, the user codes two data cards (see Figures 120 and 121). For CBMCM2 to add a panel, the user codes one header card and one to nine coordinate data cards (see Paragraph 5.3.2.1).

(c) For CBMCM to add a member the data should have 1 to 150 controls. For CBMCM2 the data should have zero to 150 controls.

(d) For CBMCM the crew station data set has SPACE=(368,2000) and DCB=(RECFM=FB, LRECL=624, BLKSIZE=624).

(e) For CBMCM, a separate data base must be created for visibility plots as described in Section 6. For CBMCM2, a separate data base is not required.

(f) For CBMCM, only the COMBIMAN seat reference point coordinate system is available to the user. For CBMCM2, both original and COMBIMAN coordinates are available to the user (see State Switch 24 in Paragraph 2.2.27).

## 5.2 RESTRICTIONS AND LIMITATIONS

The Crew Station Data Base may contain up to 20 members. The sum of the record counts for all the members may not exceed 1979 records. Information on the number of members on the Data Base and their size may be obtained by using the $PRT control card, omitting reference to any membername. Membernames are

limited to 8 alphanumeric characters. A member definition may contain a maximum of 300 panels and 300 controls. Additional limitations are described in Paragraph 5.3.2, "Processing Specifications."

An alternate program CBMCM2 creates and maintains crew station members consisting of panels with 1 to 25 vertices including open panels. The difference between CBMCM and CBMCM2 will be described wherever necessary.

## 5.3 HOW TO USE PROGRAM CBMCM

The example used to illustrate this program is based on the crew station in Figure 113, a seven-drawer desk. In modeling the desk, only the top, front side, and leg are defined. The other sides are not needed because they do not cause any physical or visual interference to the man-model seated at a desk.

### 5.3.1 Input Data Specification

Using the dimensions of the desk, and the origin as indicated in the figure, three-dimensional coordinates are obtained for the various vertices of the panels and for the locations of the controls. The program CBMCM is set up to accept crew station definitions in any three-dimensional cartesian coordinate system. The coordinate system for COMBIMAN is a right handed system (positive x forward, positive y to the left, and positive z up). The user must supply the program CBMCM with the three-dimensional coordinates of the Seat Reference Point (SRP) with respect to the origin of the crew station's coordinate system. From these data, the program converts all input coordinates of the panels and controls to the coordinate system of the COMBIMAN.

Figure 114 shows an example of a typical Aircraft Coordinate system and its related COMBIMAN Coordinate system.

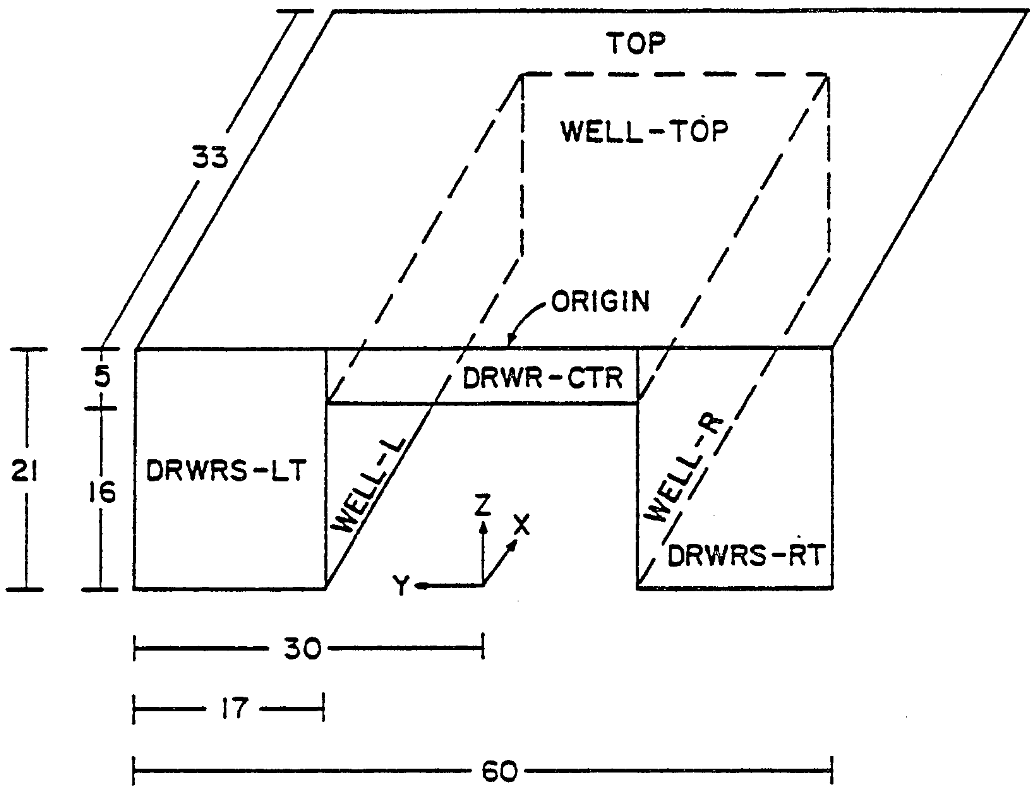



Figure 113. Sample Crew Station - DESK.

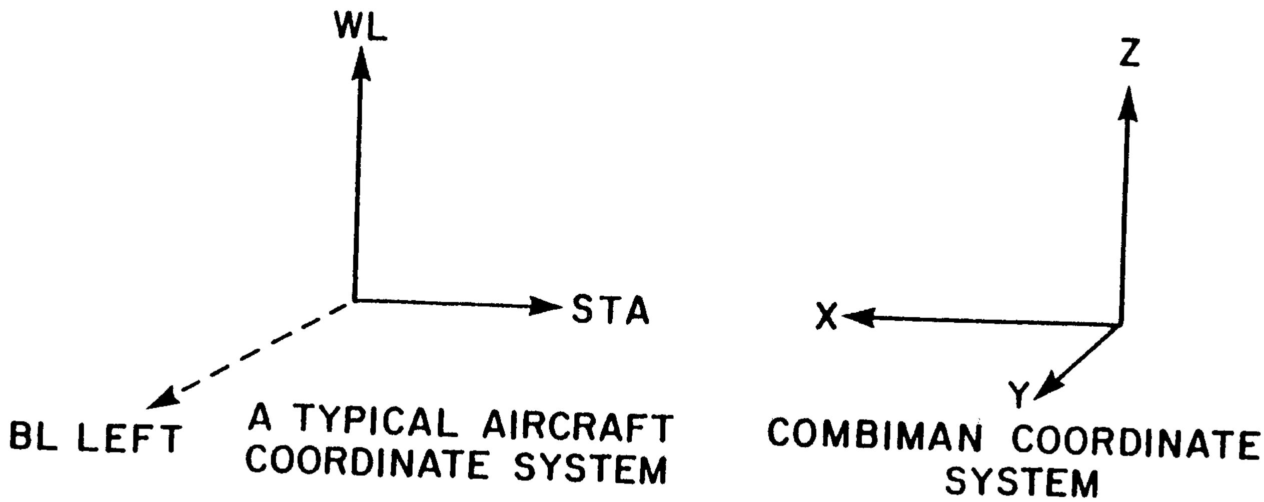



Figure 114. An Example of a Typical Aircraft Coordinate System and Its Related COMBIMAN Coordinate System.

Panels for the crew station must have three to six vertices. Coordinate data for these vertices are entered into the program consecutively, going either clockwise or counterclockwise along the perimeter of the panel. Some examples of valid and invalid panels are shown in Figure 115. A total of seven panels make up the DESK in the example. Each panel has four vertices, and is rectangular in shape. The coordinates of the vertices are shown in Figures 116 and 117. If a panel has more than 6 vertices or has a curved edge so that more than 6 vertices are required to approximate the curve, the panel must be subdivided into multiple panels of three to six vertices.

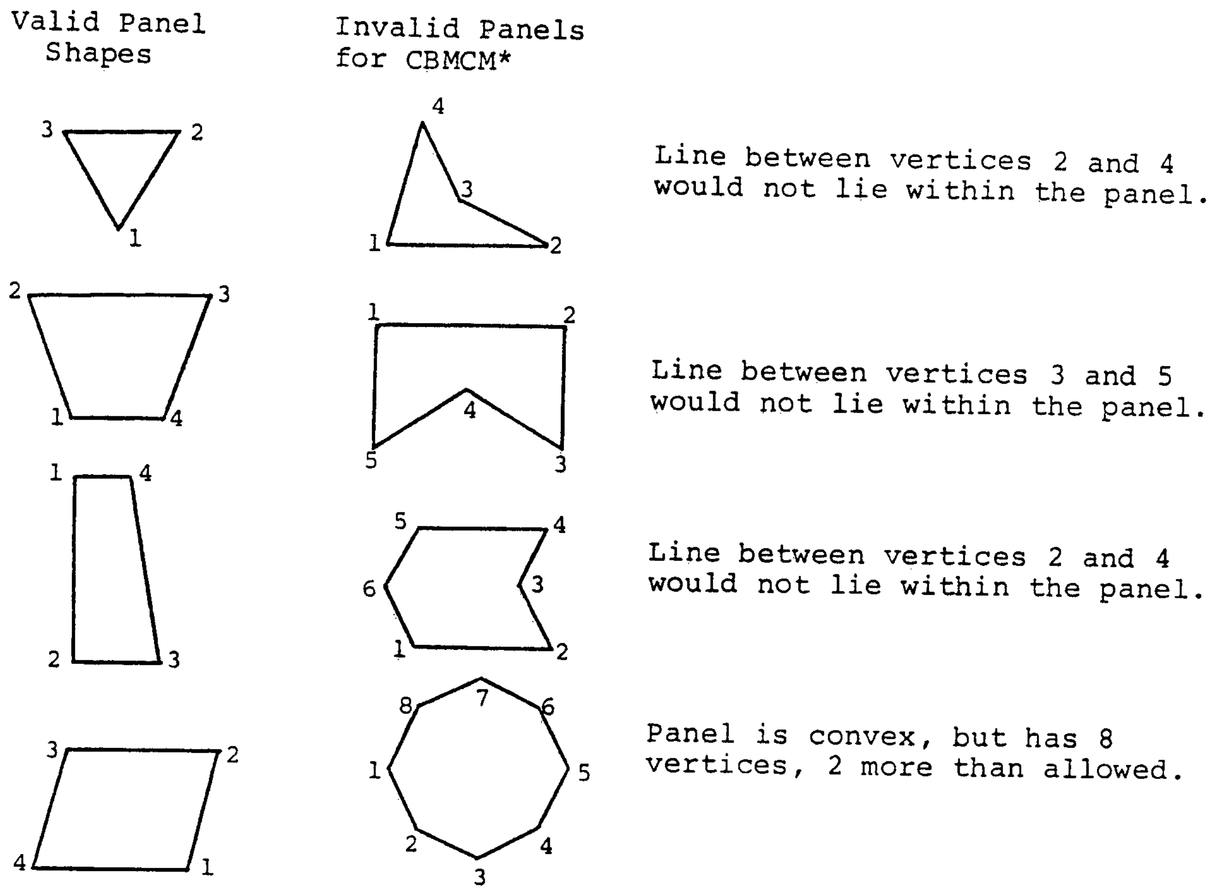
Using CBMCM2, the user may add panels with 1 to 25 vertices.

Controls are defined by either absolute or relative coordinates. If the control is not placed on a panel, it must be defined in absolute coordinates, that is, those of the crew station coordinate system. Before storing on the Data Base, the coordinates are translated and rotated to the COMBIMAN system of coordinates by CBMCM.

If the control is located on a defined panel, its coordinates can be given relative to any vertex of the panel. In this instance, the x- and y-displacements are given relative to the vertex number specified. The z-value must be zero. The x-displacement is the offset from the vertex number n in the direction of the line connecting the nth and (n-1)th vertices. The y-displacement is in direction of the line connecting nth and (n+1)th vertices. The convention for determining the location of a control in a panel relative to its vertices is shown in Figure 118.

### 5.3.2 Processing Specifications

Program CBMCM allows the user to maintain the Data Base by adding, deleting, listing, etc. the crew station definitions. The formats to request the functions are shown in Figure 119. These requests (one request per card) plus the crew



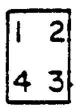

*Using CBMCM2, the only restriction on panels is that the number of vertices should be between 1 and 25.

Figure 115. Example of Valid and Invalid Panels.

1TOP

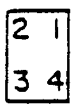

| POINT | X | Y | Z |
|---|---|---|---|
| 1 | 0.0 | 30.0 | 0.0 |
| 2 | 33.0 | 30.0 | 0.0 |
| 3 | 33.0 | -30.0 | 0.0 |
| 4 | 0.0 | -30.0 | 0.0 |

2DRWRS-LT



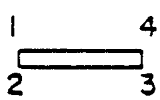

| POINT | X | Y | Z |
|---|---|---|---|
| 1 | 0.0 | 30.0 | 0.0 |
| 2 | 0.0 | 13.0 | 0.0 |
| 3 | 0.0 | 13.0 | -21.0 |
| 4 | 0.0 | 30.0 | -21.0 |

3DRWRS-RT



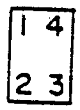

| POINT | X | Y | Z |
|---|---|---|---|
| 1 | 0.0 | -30.0 | 0.0 |
| 2 | 0.0 | -13.0 | 0.0 |
| 3 | 0.0 | -13.0 | -21.0 |
| 4 | 0.0 | -30.0 | -21.0 |

4DRWRS-CT



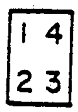

| POINT | X | Y | Z |
|---|---|---|---|
| 1 | 0.0 | 13.0 | 0.0 |
| 2 | 0.0 | 13.0 | -5.0 |
| 3 | 0.0 | -13.0 | -5.0 |
| 4 | 0.0 | -13.0 | 0.0 |

Figure 116. X, Y, and Z Coordinates of Panels of DESK.



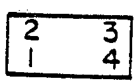

5 WELL - LT

| POINT | X | Y | Z |
|---|---|---|---|
| 1 | 0.0 | 13.0 | -5.0 |
| 2 | 0.0 | 13.0 | -21.0 |
| 3 | 33.0 | 13.0 | -21.0 |
| 4 | 33.0 | 13.0 | -5.0 |




6 WELL - RT

| POINT | X | Y | Z |
|---|---|---|---|
| 1 | 0.0 | -13.0 | -5.0 |
| 2 | 0.0 | -13.0 | -21.0 |
| 3 | 33.0 | -13.0 | -21.0 |
| 4 | 33.0 | -13.0 | -5.0 |




7 WELL - TOP

| POINT | X | Y | Z |
|---|---|---|---|
| 1 | 0.0 | 13.0 | -5.0 |
| 2 | 33.0 | 13.0 | -5.0 |
| 3 | 33.0 | -13.0 | -5.0 |
| 4 | 0.0 | -13.0 | -5.0 |

Figure 117. X, Y and Z Coordinates of Panels of DESK.

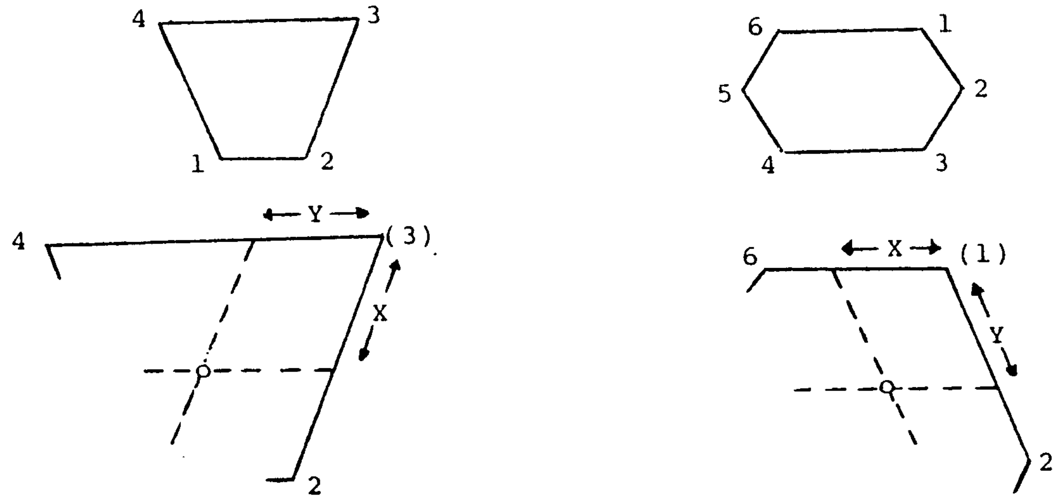



Figure 118. Convention for Determining the Location of a Control in a Panel Relative to its Vertices.

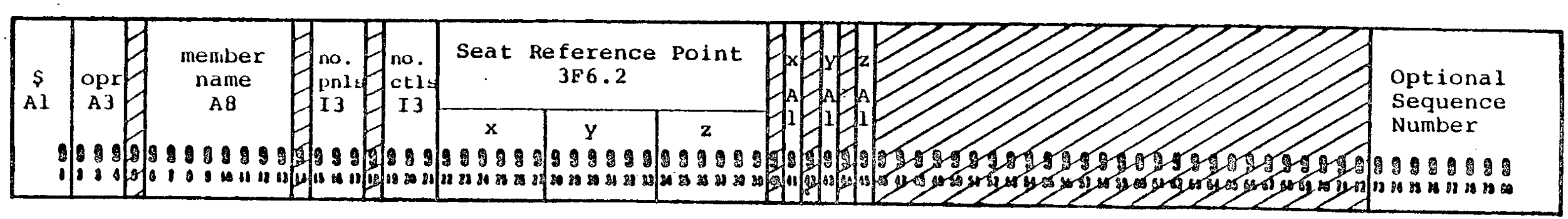



Figure 119. Program CBMCM Control Card Format.

station definitions are used as input to the program. The control cards may be input in any order with one exception: when the Data Base is initialized or reinitialized, the $INT control card must be the first input data card. The control card formats are described in the following paragraphs.

5.3.2.1 ADD CREW STATION MEMBER Function

$ADD membername npnls nctls srpx srpy srpz x y z (followed by a crew station definition)

The ADD CREW STATION MEMBER function adds the specified data under the name membername the Crew Station Data Base. The membername is limited to a length of eight characters. The crew station definition contains npnls panels, and nctls controls. These numbers should be entered as integers, right justified in their three digit fields. The Seat Reference Point (SRP) coordinates are srpx, srpy, and srpz and are entered in F6.2 Format. If a decimal point is omitted, the program CBMCM will assume a decimal point between the second and third digits from the right. The directions of the positive x, y, and z coordinate axes are indicated by the characters in the x, y, and z fields respectively. The possible values for x, y, and z are F for Forward, A for Aft, L for Left, R for Right, U for Up, and D for Down. These directions are given with respect to the seated crew member. If the crew station represents a seat, the last four letters of its membername should be "SEAT".

For each crew station panel there are two format data cards, as shown in Figure 120. In Figure 120, columns 1-3 contain an integer sequence number of the panel, right justified in the field. The first panel entered should have the sequence number "1". Panel numbers need not be consecutive, but they must be unique. Columns 4-11 contain the eight-character name of the panel. Columns 12-14 contain the panel type, as an integer, right justified. The panel types are "0" or "1" for general crew station panel, "2" for seat panel, and "3" for a rudder/brake pedal panel. If no type code is specified,

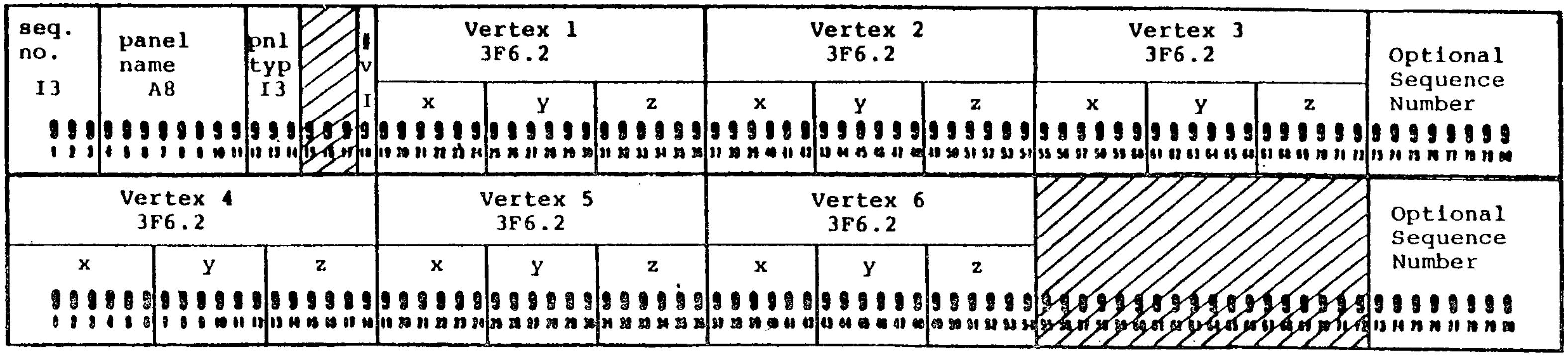



Figure 120. Program CBMCM ADD Member Card Format for Panels.

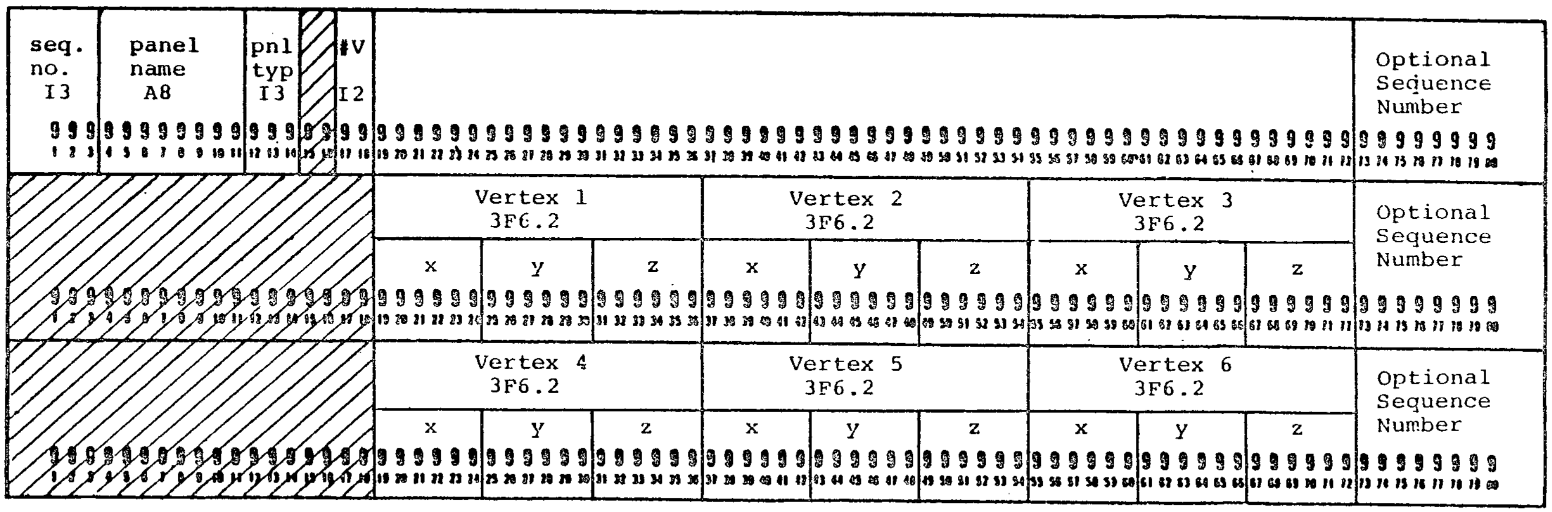



Figure 121. Program CBMCM2 ADD Member Card Format for Panels.

"1" is assumed. Column 18 contains the number of vertices of the panel; the panel must have 3 to 6 vertices. The x, y, and z coordinates of each vertex are entered consecutively, going either clockwise or counterclockwise around the perimeter of the panel.

While using CBMCM2, for each panel there is a header card and one to nine coordinate data cards as shown in Figure 121. The header card has the following format:

| | |
|---|---|
| Columns 1-3 | Sequence number of panel - Integer, right justified |
| Columns 4-11 | Name of Panel - Eight characters |
| Columns 12-14 | Panel type - Integer, right justified |
| Columns 15-18 | Number of vertices - Integer, right justified (1 to 25). |

Each coordinate data card has the following format:

| | |
|---|---|
| Columns 19-36 | x, y, and z coordinates of the first vertex in format 3F6.2 |
| Columns 37-54 | x, y, and z coordinates of second vertex in format 3F6.2 |
| Columns 55-72 | x, y, and z coordinates of third vertex in format 3F6.2 |
| Columns 73-80 | sequence number (optional) |

For example, to add a panel with 16 vertices, the user codes one header card and six coordinate data cards and to add a panel with two vertices, the user codes one header card and one coordinate data card. Sample data for creating the A7E Crew Station using the CBMCM and the CBMCM2 input formats are included in Appendix C; Figures C-6 and C-8 respectively.

Each control is defined on a card using the format in Figure 122. The control name is listed in columns 1-8. If the control is defined relative to a vertex, pnl# references a previusly defined panel and is entered as an integer value, right justified in the field. The vertex to which the control is defined relative to is specified in the one-digit field v#. If a non-zero value is entered for pnl#, a non-zero value must be entered for the field v#. If the location is relative to a defined panel, the z-field is left blank. If the location of the control is absolute, x, y, and z values must be supplied. The coordinates of the control are assumed to be real numbers. If no decimal point between the second and third digits from the right.

An example of the input definition for the member "DESK" is shown in Figure 123. The first outlined area is the $ADD control card. The second outlined area shows the panel definition cards followed by the control definition cards in outlined area (3).

If the program detects an error in the input data for a member, the member will not be added to the Data Base.

5.3.2.2 CHECK CREW STATION MEMBER Function

$CHK membername npnls nctls srpx srpy srpz x y z (followed by a crew station definition).

The CHECK CREW STATION MEMBER function operates in the same way the ADD CREW STATION MEMBER function does, EXCEPT that the member is not added. This function checks new member input data for proper format and content.

| control name A8 | control type I6 | pnl # I3 | v # I1 | control location 3F6.2 | | | | Optional Sequence Number |
|---|---|---|---|---|---|---|---|---|
| | | | | x | y | z or blank | | |

Figure 122. Program CBMCM ADD Member Card Format for Controls.

```
$ADD DESK          7   8 -15.0   0.0 -11.0 F L U
   1TOP           04   0.0  30.0   0.0  33.0  30.0   0.0  33.0 -30.0   0.0     (1)
    0.0 -30.0    0.0
   2DRWRS-LT      04   0.0  30.0   0.0   0.0  13.0   0.0   0.0  13.0 -21.0
    0.0  30.0 -21.0
   3DRWRS-RT      04   0.0 -30.0   0.0   0.0 -13.0   0.0   0.0 -13.0 -21.0
    0.0 -30.0 -21.0
   4DRWRS-CT      04   0.0  13.0   0.0   0.0  13.0  -5.0   0.0 -13.0  -5.0
    0.0 -13.0    0.0                                                          (2)
   5WELL-LT       04   0.0  13.0  -5.0   0.0  13.0 -21.0  33.0  13.0 -21.0
   33.0  13.0   -5.0
   6WELL-RT       04   0.0 -13.0  -5.0   0.0 -13.0 -21.0  33.0 -13.0 -21.0
   33.0 -13.0   -5.0
   7WELL-TOP      04   0.0  13.0  -5.0  33.0  13.0  -5.0  33.0 -13.0  -5.0
    0.0 -13.0   -5.0
L-F-CRNR       0  12   0.0   0.0
L-S-CRNR       0  11   0.0   0.0
R-F-CRNR       0  13   0.0   0.0
R-S-CRNR       0  14   0.0   0.0                                                (3)
DRWRCTNR       0  42   0.0 -13.0
DRWRLB         0  00  -1.0  22.0 -19.0
DRWRLC         0  00  -1.0  22.0 -13.0
DRWRLT         0  00  -1.0  22.0  -7.0
```

Figure 123. Sample Data for $ADD Member Function.

5.3.2.3 DELETE CREW STATION MEMBER Function

$DEL membername

The DELETE CREW STATION MEMBER function removes the specified crew station member from the Data Base, but does NOT make the space occupied by the member available for reuse. In order to make the space available to add more crew stations, the COMPRESS CREW STATION DATA BASE function must be used.

5.3.2.4 COMPRESS CREW STATION DATA BASE Function

$CMP

The COMPRESS CREW STATION DATA BASE function compresses used space together maximizing the amount of continuous unused space. The intermediate blocks of unused space are created by the DELETE CREW STATION MEMBER function. When the message "CBM127A NO SPACE, CANNOT ADD membername" appears, while adding a crew station it is necessary to use this function. If the $ADD function gives the CBM127A message immediately after the $CMP function, the Data Base is full.

5.3.2.5 DUMP CREW STATION MEMBER Function

$DMP membername
$DMP

The DUMP CREW STATION MEMBER function prints the contents of the crew station member membername, or prints the complete Crew Station Data Base if member name is omitted on the control card. The format of the display is:

```
RECORD nn + = + (record in EBCDIC          + = +
+ = + (record in hexadecimal)              + = +
+ = + (rest of record in hexadecimal)      + = +
```

The + = + characters act as delimeters of the displayed data. This function is used primarily by system programmers to test the file.

### 5.3.2.6 END PROGRAM Function

&END

The END PROGRAM function terminates execution of the program CBMCM.

### 5.3.2.7 INITIALIZE CREW STATION DATA BASE Function

$INT

The INITIALIZE CREW STATION DATA BASE function resets the Data Base to the original unused state. The primary purpose of this function is to establish a Crew Station Data Base.

### 5.3.2.8 PUNCH CREW STATION MEMBER Function

$PCH membername

The PUNCH CREW STATION MEMBER function punches a copy of the specified member in a format that the ADD CREW STATION MEMBER function requires. Specifying a membername that does not exist on the directory will result in a printout of all the membernames on the Data Base.

### 5.3.2.9 PRINT CREW STATION MEMBER Function

$PRT membername
$PRT

The PRINT CREW STATION MEMBER function prints the contents of the specified member, membername, in a format similar to that of the ADD CREW STATION MEMBER function. Specifying no name, or a nonexisting name causes a printout of the index containing membernames, their record locations on the Data Base, and the origin and orientation of their coordinate systems.

### 5.3.3 Executing CBMCM Program

The sequence of JOB CONTROL LANGUAGE (JCL) cards needed to execute the program CBMCM is shown in Figure 124. All function control cards and member definition cards follow the "//SYSIN DD*" card. The "//FT01F001" DD card included in this sequence assumes that the space for the Data Base has already been allocated on disk. If the Data Base does not exist, the "//FT01F001" DD card specified in Figure 124 should be replaced by the sequence of cards shown in Figure 125. This sequence to allocate space for the Data Base and to initialize it should be executed only once. Thereafter, the simplified "//FT01F001" DD card shown in Figure 124 should be used for all file manipulations.

Once the Data Base is allocated on Disk, it must be initialized using $INT function before using any other function. For every CBMCM job, the last function control card read into the program should be the "$END" card.

### 5.3.4 Output Data Interpretation

The program CBMCM generates output to the card punch, disk file, or printer, depending on the specified control card function. The formats for the printed output will be discussed in this section. Punched records have the same format as the input data records discussed in Paragraph 5.3.2. The physical format of the records on the Data Base is not described here.

Five basic formats are used by CBMCM for printed output. These format types, their use, and their examples are presented in this subsection. All types begin with the same heading "CBMCM", the date and time of the program execution, and page number.

```
//CBMCM     JOB HESS
//JOBLIB    DD DSN=COMBIMAN.LOADLIB,DISP=SHR                  00001000
//CBMCM     EXEC PGM=CBMCM                                    00001100
//FT01F001  DD DSN=COMBIMAN.CRSTDATA,DISP=SHR                 00001200
//FT05F001  DD DDNAME=SYSIN                                   00001300
//FT06F001  DD SYSOUT=A                                       00001400
//FT07F001  DD SYSOUT=B                                       00001500
//SYSUDUMP  DD SYSOUT=A                                       00001600
//SYSIN     DD *                                              00001700
                                                              00001800

          CBMCM FUNCTION CONTROL CARDS AND
             MEMBER DEFINITION DATA

/*
//                                                            00001900
```

Figure 124. Job Control Cards to Execute Program CBMCM. For CBMCM2, the Data Set Name is COMBIMAN.CRSTDAT2.

```
//FT01F001 DD DSN=COMBIMAN.CRSTDATA,UNIT=DISK,DISP=(NEW,CATLG),   00001300
//            VOL=SER=DISK01,SPACE=(368,2000),                    00001310
//            DCB=(BLKSIZE=368,LRECL=368,RECFM=FB)                00001320
```

Figure 125. FT01 DD Card to Allocate Space on Disk and Execute Program CBMCM. For CBMCM2, the LRECL-624, and BLKSIZE=624 for COMBIMAN.CRSTDAT2.

The first type of output is generated by the INITIALIZE, PUNCH, COMPRESS, DELETE, and END functions. The output indicates the start and end of processing associated with the specified function. For the COMPRESS function additional messages indicating that a particular member is, or is not, moved in the process of combining unused space is also printed. An example of this format, for the Compress function, is shown in Figure 126.

The second type of output is generated by the PRINT or PUNCH functions when the $PRT or $PCH control card is supplied with blank membername field. This causes the index of the Data Base printed in the following format:

<u>nn</u>.) <u>membername</u>, EXTENT=(<u>n1</u>, <u>n2</u>), <u>np</u> PANELS, <u>nc</u> CONTROLS,
ORIGIN=(<u>xx</u>, <u>yy</u>, <u>zz</u>), ORIENT=(<u>a</u>, <u>b</u>, <u>c</u>)

where:

| | |
|---|---|
| nn | is the number of the member identification record within the directory |
| <u>membername</u> | is the name of the member identified |
| <u>n1</u> | is the location of the first record which defines this member |
| <u>n2</u> | is the location of the last record which defines this member |
| <u>np</u> | is the number of panels associated with this member |
| <u>nc</u> | is the number of controls associated with this member |
| <u>xx</u><br><u>yy</u><br><u>zz</u> | is the location of the seat reference point with respect to the origin of the coordinate system of the crew station |
| <u>a</u> | is the orientation of the positive x-axis of the crew station |
| <u>b</u> | is the orientation of the positive y-axis of the crew station |
| <u>c</u> | is the orientation of the positive z-axis of the crew station |

```
CBM100I $CMP
CBM128I HAC1       WAS IN PLACE.
CBM128I A7E        WAS IN PLACE.
CBM128I A7         WAS IN PLACE.
CBM128I FWC1       WAS IN PLACE.
CBM128I A7-01      WAS IN PLACE.
CBM128I A7E-01     WAS IN PLACE.
CBM129I B1-CHAIR   NOW IN PLACE.
CBM129I B1-NAV01   NOW IN PLACE.
CBM129I B1-NAV1A   NOW IN PLACE.
CBM129I B1-NAV2A   NOW IN PLACE.
CBM129I SACR       NOW IN PLACE.
CBM129I SACL       NOW IN PLACE.
CBM129I DESK       NOW IN PLACE.
CBM138I COMPRESS FINISHED.
```

Figure 126. A Sample Output of the $CMP Function.

```
CBM100I $PRT
     9.) SACR     , EXTENT=(   782,    805),  23 PANELS,   1 CONTROLS, ORIGIN=( -27.00,  59.25, -15.75), ORIENT.=(F,R,U).
    10.) SACL     , EXTENT=(   806,    829),  23 PANELS,   1 CONTROLS, ORIGIN=( -27.00,  19.25, -15.75), ORIENT.=(F,R,U).
    11.) B1-NAV2A, EXTENT=(    754,    781),  27 PANELS,   1 CONTROLS, ORIGIN=(  22.00, 396.61,  62.50), ORIENT.=(R,A,U).
    12.) B1-CHAIR, EXTENT=(    689,    693),   4 PANELS,   1 CONTROLS, ORIGIN=(   0.0 ,   0.0 ,   0.0 ), ORIENT.=(A,R,U).
    13.) B1-NAV1A, EXTENT=(    724,    753),  29 PANELS,   1 CONTROLS, ORIGIN=(  22.00, 396.61,  62.50), ORIENT.=(R,A,U).
    14.) B1-NAV01, EXTENT=(    694,    723),  29 PANELS,   1 CONTROLS, ORIGIN=(  22.00, 396.61,  62.50), ORIENT.=(R,A,U).
    15.) A7E-01   , EXTENT=(   592,    688),  51 PANELS,  46 CONTROLS, ORIGIN=(   0.0 ,   0.0 ,   0.0 ), ORIENT.=(F,L,U).
    16.) A7-01    , EXTENT=(   489,    591),  57 PANELS,  46 CONTROLS, ORIGIN=(   0.0 ,  -5.60,  -4.25), ORIENT.=(R,F,U).
    17.) A7       , EXTENT=(   358,    460),  57 PANELS,  46 CONTROLS, ORIGIN=(   0.0 ,   0.0 ,   0.0 ), ORIENT.=(R,F,U).
    18.) FWC1     , EXTENT=(   461,    488),  27 PANELS,   1 CONTROLS, ORIGIN=(   5.00,   0.0 ,   3.00), ORIENT.=(F,L,U).
    19.) A7E      , EXTENT=(    45,    357), 204 PANELS, 109 CONTROLS, ORIGIN=(   0.0 , 103.40, 265.00), ORIENT.=(R,U,A).
    20.) HAC1     , EXTENT=(    22,     44),  18 PANELS,   5 CONTROLS, ORIGIN=(  16.00,   0.0 ,  18.00), ORIENT.=(F,L,U).
    21.) DESK     , EXTENT=(   830,    844),   7 PANELS,   8 CONTROLS, ORIGIN=( -15.00,   0.0 , -11.00), ORIENT.=(F,L,U).
```

Figure 127. A Sample Output of the $PRT (No Membername) Function.

An example of the PRINT function is shown in Figure 127.

The third type of output is generated by the DUMP function. This function is intended to be used primarily by system programmers to locate the cause of I/O (Input/Output) errors on the Data Base. For the member specified on the $DMP control card, a message giving directory or index information is printed using the second output format described elsewhere. Each data record associated with the member is printed in the following format:

```
RECORD nn + = + (recorded in EBCDIC)              + = +
+ = + (record in hexadecimal)                     + = +
+ = + (remainder of record in hexadecimal)        + = +
```

where nn is the location of the record within the Data Base. The record in EBCDIC is printed using a 25A4 format. The record in hexadecimal is printed using a 10Z8 format. An example of the output for the DUMP function is shown in Figure 128.

The fourth output format is used by the CHECK and ADD functions. After reading the control card and checking it for errors, the information contained on the card is printed first.

The panel definition cards, after being read and checked for errors, are printed in the following format:

$\underline{nn}$.) $\underline{pnl\ nm}$, TYPE=$\underline{tt}$, $\underline{nv}$ VERTICES--INPUT COORD-- -- ABSOLUTE COORD --

$(\underline{xx}_1, \underline{yy}_1, \underline{zz}_1)$ $(\underline{ax}_1, \underline{ay}_1, \underline{ax}_1)$

$(\underline{xx}_{nv}, \underline{yy}_{nv}, \underline{zz}_{nv})$ $(\underline{ax}_{nv}, \underline{ay}_{nv}, \underline{ax}_{nv})$

where:

| | |
|---|---|
| $\underline{nn}$ | is the panel number |
| $\underline{pnl\ nm}$ | is the panel name |
| $\underline{tt}$ | is the panel type |
| $\underline{nv}$ | is the number of vertices used to define the panel |

```
CBH100I $DMP DESK
   21.1 DESK     , EXTENT=(      830,      844),    7 PANELS,    8 CONTROLS, ORIGIN=( -15.00,    0.0 , -11.00), ORIENT.=(F,L,U).
 RECORD  830+=+      TOP              0                                    B          0  B
+=+00000001E3D6D7404040404000C0000000000000441F00000421E0000418000 0C4230000421E000041800000423000000+=+        +=+
+=+C21E00004180000041F00000C21E0000418000000000000000000000000000000000000000000000000000000000+=+
 RECORD  831+=+      DRWRS-LT         0              0              0      A     0       A
+=+00000002C4D9E6D9E26003E30000000000000000441F00000421E00004180000041F000004100000041800000041F00000+=+   +=+
+=+41D000000C1A00000041F00000421E0000C1A000C00000000000000000000000000000000000000000000000+=+
 RECORD  832+=+      DRWRS-RT         0  B           0  A           0  A    A     0  B     A
+=+00000003C4D9E6D9E26009E300000000000000000441F00000C21E00004180000041F00000C1D00000418000 0041F00000+=+  +=+
+=+C1D00000C1A0000041F00000C21E0000C1A000C000000000000000000000000000000000000000000000000+=+
 RECORD  833+=+      DRWRS-CT         0              0         -    0  A      -    0  A
+=+00000004C4D9E6D9E260C3E300000000000000000441F000004100000041800000041F00000410000041600000041F00000+=+  +=+
+=+C1D0000041600000041F00000C1D0000041800000000000000000000000000000000000000000000000000+=+
 RECORD  834+=+      WELL-LT          0          -   0       A            A                -
+=+00000005E6C5D3D360D3E340000000000000000441F000004100000041600000041F000004100000C1A0000042300000+=+   +=+
+=+41D000000C1A000004230000041000000416000000000000000000000000000000000000000000000000+=+
 RECORD  835+=+      WELL-RT          0  A      -    0  A    A       A    A       A      -
+=+00000006E6C5D3D36009E34000000000000000000441F00000C1D000000416000000041F00000C1D00000C1A0000042300000+=+  +=+
+=+C1D00000C1A00000423000000C1D000004160000000000000000000000000000000000000000000000000+=+
 RECORD  836+=+      WELL-TOP         0          -              -        A    -    0  A      -
+=+00000007E6C5D3D360E3D6D70000000000000000441F00000410000004160000004230000041D00000416000004230000+=+   +=+
+=+C1D0000041600000041F00000C1D000004160C000000000000000000000000000000000000000000000000+=+
 RECORD  837+=+L-F-CRNR
+=+D360C660C3D9D5D9000000000000000010000000242300000421E000041800000000000000000000000000000000000000+=+  +=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
 RECORD  838+=+L-S-CRNR               0
+=+D360E260C3D9D5D9000000000000000010000000141F00000421E000041800000C0000000000000000000000000000000C+=+  +=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
 RECORD  839+=+R-F-CRNR                 B
+=+D960C660C3D9D5D9000000000000000010000000342300000C21E0000418000000000000000000000000000000000000000+=+  +=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
 RECORD  840+=+R-S-CRNR               0  B
+=+D960E260C3D9D5D9000000000000000010000000441F00000C21E0000418000000000000000000000000000000000000000+=+  +=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
 RECORD  841+=+DRWRCTNR               0          -        A
+=+C4D9E6D9C3E3D5D900000000000000004000000241F0000C0000000041600000000000000C1D000000000000000000000000+=+  +=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
 RECORD  842+=+DRWRLB                    A
+=+C4D9E6D9D3C24040000000000000000000000000041E000004216000 0C1800000000000000000000000000000000000000+=+  +=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
 RECORD  843+=+DRWRLC                    A
+=+C4D9E6D9D3C34040000000000000000000000000041E0000042160000C1200000000000000000000000000000000000000+=+  +=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
 RECORD  844+=+DRWRLT
+=+C4D9E6D9D3E34040000000000000C00000000000000041E000004216000041400000000000000000000000000000000000+=+  +=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
```

Figure 128. A Sample Output of the $DMP Function.

$\underline{xx}_i, \underline{yy}_i, \underline{zz}_i$ — are the x, y, and z coordinates for the ith vertex of the panel, in the crew station system of coordinates, where i=1, nv.

$\underline{ax}_i, \underline{ay}_i, \underline{ax}_i$ — are the x, y, and z coordinates of the ith vertex of the panel, converted to the COMBIMAN system of coordinates, where i=1, nv.

After all the panel definition data are printed, CBMCM printes the control data using the following format:

<u>cntl nm</u> <u>tt</u> <u>pnl ref.</u> <u>v.#</u> (<u>xx</u>,<u>yy</u>,<u>zz</u>) TO (<u>ax</u>,<u>ay</u>,<u>ax</u>) & (<u>rx</u>,<u>ry</u>)

where:

<u>cntl nm</u> — is the 8 character name of the control

<u>tt</u> — is the 2 digit control type

<u>pnl ref</u> — is the panel where the control is located (if applicable)

<u>v.#</u> — is the reference vertex number for that control (if applicable)

<u>xx</u>
<u>yy</u>
<u>zz</u> — are the three-dimensional coordinates (relative or absolute) which define the location of the control

<u>ax</u>
<u>ay</u>
<u>ax</u> — are the three-dimensional coordinates which define the location of the control in the COMBIMAN system of coordinates

<u>rx</u>
<u>ry</u> — are the two-dimensional relative coordinates of the control. If the control is not defined relative to a panel, rx=ry=0.0.

An example of this fourth output format for the $ADD function is shown in Figure 129.

The fifth and last format is similar to that used for the ADD function input, and is used for the PRINT function when a valid membername is specified. The main difference between this format and the fourth is that this format does not print the original input data used to add the member to the Data Base. After printing the index record for the member, the

```
CBM100I $ADD DESK          7   8-15.00  0.0 -11.00 F L U
CBM119I MEMBER, DESK        , HAS    7 PANELS AND    8 CONTROLS.
CBM120I COORDINATES ARE TRANSLATED TO ( -15.00,     0.0 , -11.00).
CBM121I COORDINATES GIVEN AS F, L AND U ARE NOW F, L, AND U.
        1.) TOP       , TYPE= 0, 4 VERTICES --INPUT COORDINATES---      --ABSOLUTE COORDINATES-
                                            (  0.0    30.00    0.0 ) TO (  15.00  30.00  11.00)
                                            ( 33.00   30.00    0.0 ) TO (  48.00  30.00  11.00)
                                            ( 33.00  -30.00    0.0 ) TO (  48.00 -30.00  11.00)
                                            (  0.0   -30.00    0.0 ) TO (  15.00 -30.00  11.00)
        2.) DRWRS-LT, TYPE= 0, 4 VERTICES --INPUT COORDINATES---      --ABSOLUTE COORDINATES-
                                            (  0.0    30.00    0.0 ) TO (  15.00  30.00  11.00)
                                            (  0.0    13.00    0.0 ) TO (  15.00  13.00  11.00)
                                            (  0.0    13.00  -21.00) TO (  15.00  13.00 -10.00)
                                            (  0.0    30.00  -21.00) TO (  15.00  30.00 -10.00)
        3.) DRWRS-RT, TYPE= 0, 4 VERTICES --INPUT COORDINATES---      --ABSOLUTE COORDINATES-
                                            (  0.0   -30.00    0.0 ) TO (  15.00 -30.00  11.00)
                                            (  0.0   -13.00    0.0 ) TO (  15.00 -13.00  11.00)
                                            (  0.0   -13.00  -21.00) TO (  15.00 -13.00 -10.00)
                                            (  0.0   -30.00  -21.00) TO (  15.00 -30.00 -10.00)
        4.) DRWRS-CT, TYPE= 0, 4 VERTICES --INPUT COORDINATES---      --ABSOLUTE COORDINATES-
                                            (  0.0    13.00    0.0 ) TO (  15.00  13.00  11.00)
                                            (  0.0    13.00   -5.00) TO (  15.00  13.00   6.00)
                                            (  0.0   -13.00   -5.00) TO (  15.00 -13.00   6.00)
                                            (  0.0   -13.00    0.0 ) TO (  15.00 -13.00  11.00)
        5.) WELL-LT , TYPE= 0, 4 VERTICES --INPUT COORDINATES---      --ABSOLUTE COORDINATES-
                                            (  0.0    13.00   -5.00) TO (  15.00  13.00   6.00)
                                            (  0.0    13.00  -21.00) TO (  15.00  13.00 -10.00)
                                            ( 33.00   13.00  -21.00) TO (  48.00  13.00 -10.00)
                                            ( 33.00   13.00   -5.00) TO (  48.00  13.00   6.00)
        6.) WELL-RT , TYPE= 0, 4 VERTICES --INPUT COORDINATES---      --ABSOLUTE COORDINATES-
                                            (  0.0   -13.00   -5.00) TO (  15.00 -13.00   6.00)
                                            (  0.0   -13.00  -21.00) TO (  15.00 -13.00 -10.00)
                                            ( 33.00  -13.00  -21.00) TO (  48.00 -13.00 -10.00)
                                            ( 33.00  -13.00   -5.00) TO (  48.00 -13.00   6.00)
        7.) WELL-TOP, TYPE= 0, 4 VERTICES --INPUT COORDINATES---      --ABSOLUTE COORDINATES-
                                            (  0.0    13.00   -5.00) TO (  15.00  13.00   6.00)
                                            ( 33.00   13.00   -5.00) TO (  48.00  13.00   6.00)
                                            ( 33.00  -13.00   -5.00) TO (  48.00 -13.00   6.00)
                                            (  0.0   -13.00   -5.00) TO (  15.00 -13.00   6.00)
          CONTROL- TYPE IN PANEL POINT ---INPUT COORDINATES---      --ABSOLUTE COORDINATES-  RELATIVE-COORDINATES
          -------- ---- -------- ----- ---------------------      ----------------------   -------------------
          L-F-CRNR   0  TOP        2   (  0.0    0.0     0.0 ) TO (  48.00  30.00  11.00) & (  0.0    0.0 )
          L-S-CRNR   0  TOP        1   (  0.0    0.0     0.0 ) TO (  15.00  30.00  11.00) & (  0.0    0.0 )
          R-F-CRNR   0  TOP        3   (  0.0    0.0     0.0 ) TO (  48.00 -30.00  11.00) & (  0.0    0.0 )
          R-S-CRNR   0  TOP        4   (  0.0    0.0     0.0 ) TO (  15.00 -30.00  11.00) & (  0.0    0.0 )
          DRWRCTNR   0  DRWRS-CT   2   (  0.0  -13.00    0.0 ) TO (  15.00   0.0    6.00) & (  0.0  -13.00)
          DRWRLB     0             0   ( -1.00  22.00  -19.00) TO (  14.00  22.00  -8.00) & (  0.0    0.0 )
          DRWRLC     0             0   ( -1.00  22.00  -13.00) TO (  14.00  22.00  -2.00) & (  0.0    0.0 )
          DRWRLT     0             0   ( -1.00  22.00   -7.00) TO (  14.00  22.00   4.00) & (  0.0    0.0 )
CBM134I DESK      WITH     7 PANELS AND     8 CONTROLS HAS BEEN ADDED.
```

Figure 129. Example of Program CBMCM $ADD (Membername) Function Output Format.

program CBMCM prints the panel definition data in the following format:

nn.) pnl nm, TYPE=tt, nv VERTICES--ABSOLUTE COORDINATES--
$(xx_1, yy_1, zz_1)$
.
.
.
$(xx_{nv}, yy_{nv}, zz_{nv})$

where:

| | |
|---|---|
| nn | is the panel number |
| pnl nm | is the 8-charcter name of the panel |
| tt | is the panel type |
| nv | is the number of vertices which define the panel |
| $xx_i, yy_i, zz_i$ | are the x, y, and z coordinates of the ith vertex of the panel, in the COMBIMAN system of coordinates, where i=1, nv. |

After printing the panel definition data, the program prints the control data using the following format:

cntl nm tt pnl ref v# (ax, ay, az) (rx, ry)

where:

| | |
|---|---|
| cntl nm | is the 8 character name of the control |
| tt | is the 2 digit control type |
| pnl ref | is the panel on which the control is located (if applicable) |
| v# | is the reference vertex number of the panel for that control (if applicable) |
| ax<br>ay<br>az | are the three-dimensional coordinates which define the control in the COMBIMAN system of coordinates |
| rx<br>ry | are the two-dimensional relative coordinates of the control. If the control was not defined relative to a panel, rx=ry=0.0. |

An example of the output for the $PRT function using the fifth format is shown in Figure 130.

```
CBMIOOI $PRT DESK
        21.) DESK      , EXTENT=(     830,      844),    7 PANELS,    8 CONTROLS, ORIGIN=( -15.00,    0.0 , -11.00), ORIENT.=(F,L,U).
         1.) TOP       , TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                              (  15.00  30.00  11.00)
                                              (  48.00  30.00  11.00)
                                              (  48.00 -30.00  11.00)
                                              (  15.00 -30.00  11.00)
         2.) DRWRS-LT, TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                              (  15.00  30.00  11.00)
                                              (  15.00  13.00  11.00)
                                              (  15.00  13.00 -10.00)
                                              (  15.00  30.00 -10.00)
         3.) DRWRS-RT, TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                              (  15.00 -30.00  11.00)
                                              (  15.00 -13.00  11.00)
                                              (  15.00 -13.00 -10.00)
                                              (  15.00 -30.00 -10.00)
         4.) DRWRS-CT, TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                              (  15.00  13.00  11.00)
                                              (  15.00  13.00   6.00)
                                              (  15.00 -13.00   6.00)
                                              (  15.00 -13.00  11.00)
         5.) WELL-LT , TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                              (  15.00  13.00   6.00)
                                              (  15.00  13.00 -10.00)
                                              (  48.00  13.00 -10.00)
                                              (  48.00  13.00   6.00)
         6.) WELL-RT , TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                              (  15.00 -13.00   6.00)
                                              (  15.00 -13.00 -10.00)
                                              (  48.00 -13.00 -10.00)
                                              (  48.00 -13.00   6.00)
         7.) WELL-TOP, TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                              (  15.00  13.00   6.00)
                                              (  48.00  13.00   6.00)
                                              (  48.00 -13.00   6.00)
                                              (  15.00 -13.00   6.00)
      CONTROL- TYPE IN-PANEL POINT --ABSOLUTE COORDINATES-  RELATIVE-COORDINATE
      -------- ---- -------- ----- ----------------------  -------------------
      L-F-CRNR    0 TOP        2   (, 48.00  30.00  11.00)  (   0.0     0.0 )
      L-S-CRNR    0 TOP        1   (  15.00  30.00  11.00)  (   0.0     0.0 )
      R-F-CRNR    0 TOP        3   (  48.00 -30.00  11.00)  (   0.0     0.0 )
      R-S-CRNR    0 TOP        4   (  15.00 -30.00  11.00)  (   0.0     0.0 )
      DRWRCTNR    0 DRWRS-CT   2   (  15.00   0.0    6.00)  (   0.0   -13.00)
      DRWRLB      0            0   (  14.00  22.00  -8.00)  (   0.0     0.0 )
      DRWRLC      0            0   (  14.00  22.00  -2.00)  (   0.0     0.0 )
      DRWRLT      0            0   (  14.00  22.00   4.00)  (   0.0     0.0 )
```

Figure 130. A Sample Output the $PRT Function.

## 5.4 PROGRAM MESSAGES - INCLUDING ERROR CORRECTION

The program CBMCM prints both information and action related messages. The message format is as follows:

CBMlnni message test

where:

| | |
|---|---|
| nn | is the message number |
| i | indicates the action code (I=Informational, A=Action to be performed), and |
| message text | is the text of the message. |

Unless otherwise noted, all messages are generated by the routine CBMCM.

The messages are as follows:

**CBM100I** control card image.

| | |
|---|---|
| Reason: | User submitted a control card. |
| System Action: | Continues processing. |
| User Action: | None. |

**CBM101A** operation UNKNOWN OPERATION.

| | |
|---|---|
| Reason: | The operation on the control card shown in the previous CBM100I message, is unknown. |
| System Action: | Ignores this control card. |
| User Action: | Correct the card and resubmit. |

**CBM102A** panelnumber INVALID PANEL NUMBER FOR POINT controlname.

| | |
|---|---|
| Reason: | The panel number specified by the control definition card does not exist. |
| System Action: | Assumes that the control is defined in absolute coordinates. |
| User Action: | Delete the crew station member, correct the card, and resubmit. |

CBM103A vertexnumber INVALID VERTEX NUMBER FOR POINT controlname.

| | |
|---|---|
| Reason: | The panel in which the control is defined does not have vertex vertexnumber. |
| System Action: | Uses vertex number 1. |
| User Action: | Delete the crew station member, correct the error, and resubmit. |

CBM104A Z NOT ZERO, PANEL & VERTEX NOW ZERO FOR POINT controlname.

| | |
|---|---|
| Reason: | A panel number and a vertex number are specified, but the Z value is not zero. |
| System Action: | Makes Z zero and continues processing. |
| User Action: | If setting Z equal to zero corrects the problem, no action needed. Otherwise, delete the crew station member, correct the data card and resubmit. |

CBM105A NO NAME GIVEN, operation IGNORED.

| | |
|---|---|
| Reason: | This operation requires a crew station member name, but no name is specified. |
| System Action: | Ignores the operation. |
| User Action: | Supply the member name and resubmit. |

CBM106A membername NOT FOUND.

| | |
|---|---|
| Reason: | For the DELETE, DUMP, PUNCH or PRINT function, the specified crew station member name does not exist. |
| System Action: | Prints the Crew Station Data Base directory. |
| User Action: | Correct the error and resubmit. |

CBM107A NUMBER OF PANELS/CONTROLS INVALID FOR MEMBER membername.

| | |
|---|---|
| Reason: | The number of panels or controls as specified on the ADD function control card ($ADD) is either less than 1 or greater than 300. |
| System Action: | Ignores the control card. |
| User Action: | If the number as specified is less than 1, correct and resubmit. If the number as specified is greater than 300, split the crew station definition into two units and add them separately. |

CBM108A DIRECTION FOR X INVALID, MEMBER IS membername.

| | |
|---|---|
| Reason: | During the ADD function ($ADD), the direction of the user's X-axis is not F, A, L, R, U or D. |
| System Action: | Ignores the control card. |
| User Action: | Correct the control card and resubmit. |

CBM109A DIRECTION FOR Y INVALID, MEMBER IS membername.

| | |
|---|---|
| Reason: | During the ADD function ($ADD), the direction of the user's Y-axis is not F, A, L, R, U or D. |
| System Action: | Ignores the control card. |
| User Action: | Correct the control card and resubmit. |

CBM110A DIRECTION FOR Z INVALID, MEMBER IS membername.

| | |
|---|---|
| Reason: | During the ADD function ($ADD), the direction of the user's Z-axis is not F, A, L, R, U or D. |
| System Action: | Ignores the control card. |
| User Action: | Correct the control card and resubmit. |

CBM111A X&Y, X&Z OR Y&Z ARE COLINEAR FOR MEMBER membername.

| | |
|---|---|
| Reason: | The directions of two or more of the user's axes are the same (ex. X=L, Y=U, & Z=U or X=L, Y=U & Z=L). |
| System Action: | Ignores the control card. |
| User Action: | Pick unique directions for the axes and resubmit. |

CBM112A DIRECTORY IS FULLY, CANNOT ADD membername.

| | |
|---|---|
| Reason: | No space is available in the Crew Station Data Base directory to add an entry for this member. |
| System Action: | Ignores the control card. |
| User Action: | Delete a member and resubmit. |

CBM113A PANEL IS ZERO, BUT POINT IS NOT FOR membername.

| | |
|---|---|
| Reason: | In defining a control, either the panel number and the vertex number must be zero, or both numbers must be non-zero. Note that blank entry is converted to zero. |
| System Action: | Takes the control definition as absolute. |
| User Action: | Delete the crew station, correct the error and resubmit. |

CBM114A membername ALREADY EXISTS.

Reason: User tried to add a crew station definition under a name that already exists on the Data Base.

System Action: Ignores the control card.

User Action: Use a new name, and resubmit.

CBM115A END OF DATA.

Reason: The end of file was found before the END Program control card ($END).

System Action: Terminates the program.

User Action: Check to make sure that all the control cards are processed.

CBM116A I/O ERROR ON RECORD recordnumber (INDEX).

Reason: An I/O error occurred on the Crew Station Data Base.

System Action: Terminates the program.

User Action: Contact systems programmer.

CBM117A I/O ERROR ON RECORD recordnumber (DATA).

Reason: An I/O error occurred on the Crew Station Data Base.

System Action: Terminates the program.

User Action: Contact systems programmer.

CBM119A NEW MEMBER, membername, HAS nn PANELS AND nn CONTROLS.

Reason: The user added a crew station definition to the Data Base.

System Action: The new crew station is added to the Data Base.

User Action: None.

CBM120I COORDINATES ARE TRANSLATED TO seat reference point coordinate.

Reason: The user added a crew station definition to the Data Base.

System Action: The addition is accepted.

User Action: None.

CBM121I COORDINATES GIVEN AS axis, axis AND axis ARE NOW R, F, AND U.

Reason: The user added a crew station definition to the Data Base.

System Action: The addition is accepted.

User Action: None.

CBM122I PROGRAM END.

| | |
|---|---|
| Reason: | The End Program function control card ($END) or the end of the file card is encountered, or there is an I/O error. |
| System Action: | Terminates the program. |
| User Action: | Check to make sure that all control cards are accepted, and processed correctly. |

CBM123I membername DELETED.

| | |
|---|---|
| Reason: | The user submittd a delete Crew Station Definition function control ($DEL). |
| System Action: | Makes the requested deletion. |
| User Action: | None. |

CBM124I INITIALIZED.

| | |
|---|---|
| Reason: | The user requested that the Crew Station Data Base be initialized. |
| System Action: | The Data Base is initialized. |
| User Action: | None. |

CBM125A PANEL NOT DEFINED FOR CONTROL controlname.

| | |
|---|---|
| Reason: | To define a control, the user specified the control in a panel not found in this crew station. |
| System Action: | Assumes that the control is defined absolutely. |
| User Action: | Make sure that the panel is defined. Correct the resubmit. |

CBM126I membername PUNCHED.

| | |
|---|---|
| Reason: | The user requested that member membername be punched on cards. |
| System Action: | Punches the data. |
| User Action: | None. |

CBM127A NO SPACE, CANNOT ADD membername.

| | |
|---|---|
| Reason: | There is not enough space in the data base to hold the requested addition. |
| System Action: | Ignores the control card. |
| User Action: | Compress the Data Base and resubmit. |

CBM128I membername WAS IN PLACE.

Reason: The user requested that the Data Base be compressed. The member, membername, was already compressed and not moved.

System Action: The name member was not moved.

User Action: None.

CBM129I membername NOW IN PLACE.

Reason: The user requested that the Data Base be compressed. The member, membername was not in place, and therefore has been moved to facilitate compression.

System Action: The member is moved to another location in the Data Base.

User Action: None.

CBM130A panelname USED IN PANELS $panelnumber_1$ AND $panelnumber_2$.

Reason: In the crew station member definition, two panels have the same name. The number of these panels are $panelnumber_1$ and $panelnumber_2$.

System Action: Both panels are accepted in spite of the duplicate names.

User Action: Delete the definition, change one of the names, and resubmit.

CBM131A panelname HAS SAME PANEL NUMBER AS panelnumber.

Reason: In the crew station definition, two panels have the same panel number.

System Action: Both panels are accepted. Note that references to the second will cause a reference to the first.

User Action: Delete the crew station definition, correct the error, and resubmit.

CBM132A controlname IS A DUPLICATE NAME.

Reason: In adding a crew station definition, two controls have the same name.

System Action: Only the first control can be referenced.

User Action: Delete the definition, change one of the names to make it unique, and resubmit.

# SECTION 6

## COMBIMAN VISION LIMIT OVERLAY DATA BASE MAINTENANCE PROGRAM (CBMOM)

The VISION LIMIT OVERLAY DATA BASE is used by the VISIBILITY ANALYSIS function (PFK6). This function displays the rectilinear projection of the crew station from the eye location of the current man-model, the three-dimensional coordinates of the selected crew station, and vision limit overlays stored in the VISION LIMIT OVERLAY DATA BASE.

The field surrounded by a "vision limit overlay" is the total field of vision relative to the head. The field of peripheral vision is what COMBIMAN can see with no restrictive head gear. If head gear is added which limits vision, the field becomes smaller. If the user has data describing a restriction to vision, a new overlay can be constructed and added to the data base using the procedure in this section. Up to 15 members can reside in the data base and be selected for display in the overlay menu when PFK6 is selected. By using the CBMOM program to change or create the VISION LIMIT OVERLAY DATA BASE the user can receive plots of several different type of protective head gear.

### 6.1 PROCESSING CAPABILITIES

The program CBMOM allows the user to create and change the VISION LIMIT OVERLAY Data Base. Input data are supplied on 80-character computer cards, or card images on magnetic tape, or direct access device, and are processed according to the user's selection of control commands. These commands allows the user to add or delete members, to print information about existing members, or to list contents of the Data Base.

The control cards may be input in any order with one exception: when the Data Base is created for the first time or is re-initialized, the $INT (initialize) control card must precede all other control cards and member definitions.

## 6.2 RESTRICTIONS AND LIMITATIONS

A maximum of 15 overlay members may reside in the VISION LIMIT OVERLAY DATA BASE. Each member may contain up to 100 points made up of X and Y coordinates.

## 6.3 HOW TO USE CBMODM

A fictitious vision limit overlay is used to illustrate data collection and data transformation for the ADD Member function (Paragraph 6.3.2.1) of the CBMODM program. The data collected for a vision limit overlay can be in many forms. The following sections gives two common ways data could be collected and transformed for input to ADD Member function.

### 6.3.1 Input Data Specification

Data describing a restriction to vision would be collected with a peripheral vision testing device. There are a variety of commercial and non-commercial devices available. Figure 131 and 132 described two devices commonly used to measure field of vision limits.

The data collected from the device shown in Figure 132 is in azimuth/elevation angles and can be entered directly into the data base. The data collected from the device in Figure 131 will need to be converted into azimuth/elevation angles. The device in Figure 131 will give two angles, the angle of the protractor plane (A) arm and the angle from forward (B). The angle of the protractor plane will be between 0 and 360 degrees,

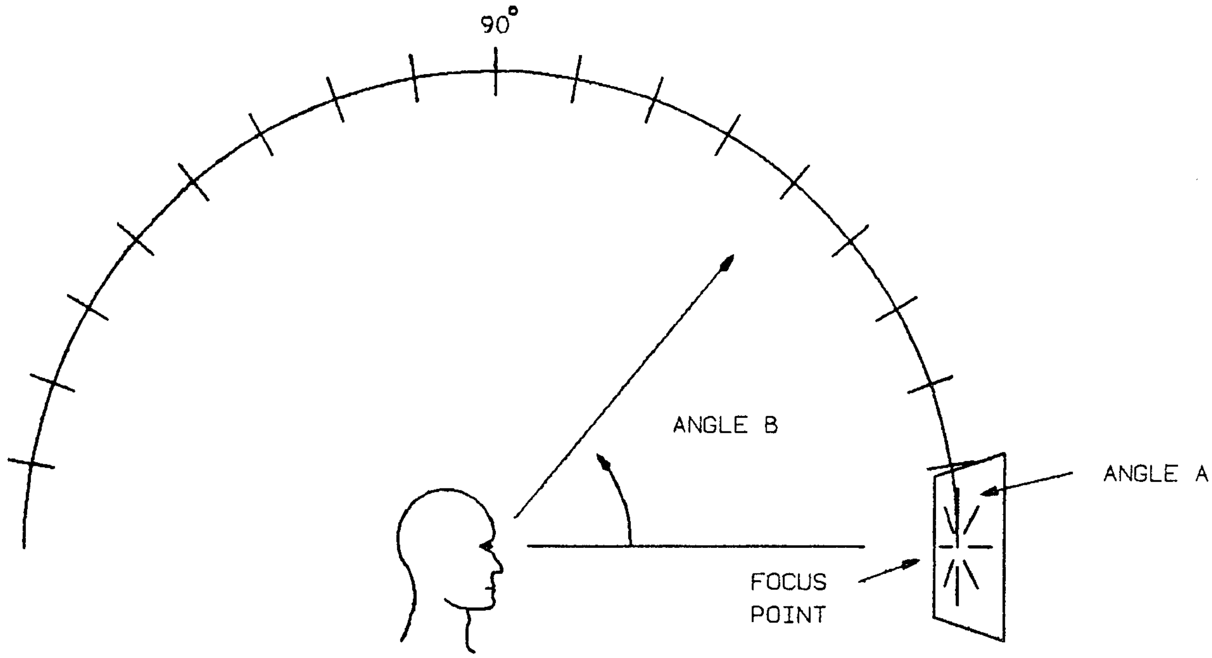



Figure 131. Device 1: Subject Faces the Horizontal Pivot of a Semicircular Protrctor Which Pivots About the Longitude Axis. Data describes (first) the angle of the protractor plane (Angle A) and (second) the angle of vision limit in that plane (Angle B).

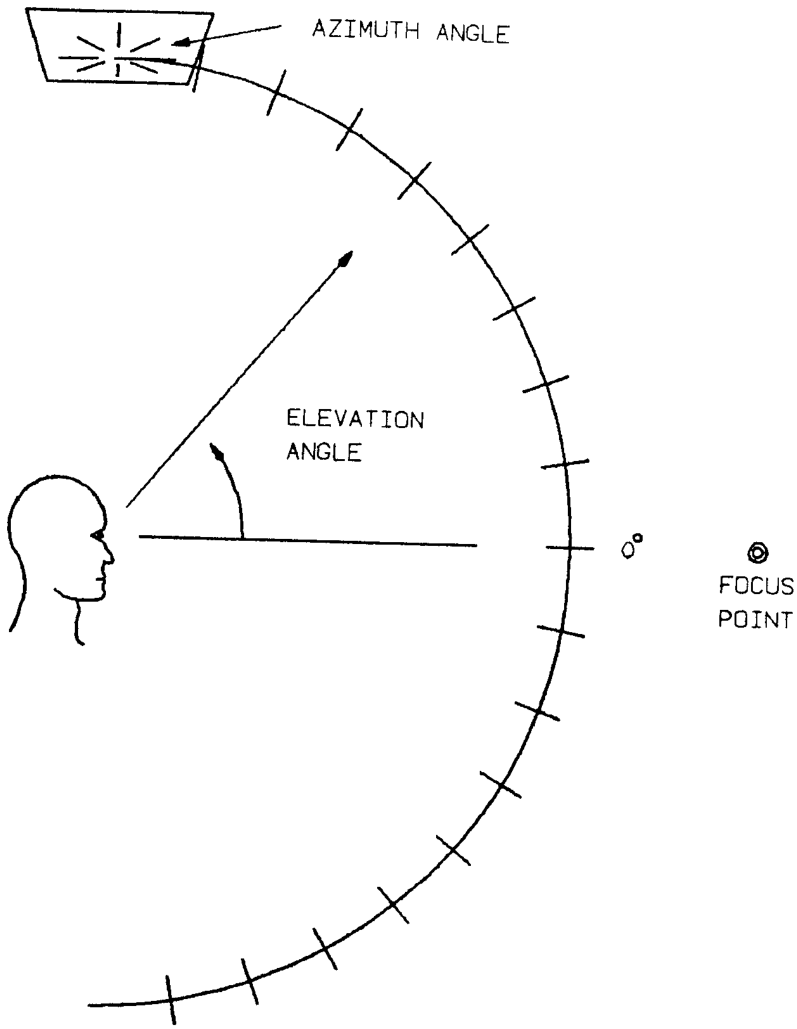



Figure 132. Device 2: Subjects Sit Beneath the Verticl Pivot of a Semicircular Protractor. Data describes (first) the azimuth angle (left or right of forward) and the elevation angle (above or below horizontal). This azimuth/elevation data can be entered directly into the data base without transformation.

and the angle from forward will be between 0 and 180 degrees. An example of the data collected for a fictitious vision limit overlay is shown in Figure 133 where angle A is the angle of the protractor plane and angle B is the vision limit angle for forward. The data has to be converted to Azimuth and Elevation angles for input for the ADD MEMBER function. The following equations will convert the spherical angles to rectangular (azimuth, elevation) angles:

$$\text{Elevation angle} = \sin^{-1} (\sin A \sin B)$$

$$\text{Azimuth angle} = \cos^{-1} (\cos B / \cos (\sin^{-1} (\sin A \sin B))$$

A - angle of the protractor plane.

B - angle from forward.

NOTE: The azimuth angle should be given a positive sign for points to the right of forward; negative if left of forward. If the vision limits are symmetrical (they usually are) only the points at the center and right of center need be converted. The points to the left can be obtained by changing the sign of the azimuth angle.

Figure 134 shows the transformed data. Once the data is transformed the ADD MEMBER function can be used to add a new member to the VISION LIMIT OVERLAY DATA BASE.

The VISION LIMIT OVERLAY DATA BASE Maintenance Program scales the azimuth/elevation coordinate pairs so that they may be superimposed on the visibility plots. A smooth curve will be generated to fit the points provided. It is recommended that no fewer than eight coordinate pairs be used. Although 100 pairs may be entered, increasing the set beyond 36 pairs does not cause a significant difference in the shape of the vision envelope.

| ANGLE A | ANGLE B |
|---|---|
| 0 | 90 |
| 45 | 70 |
| 90 | 60 |
| 135 | 70 |
| 180 | 90 |
| 225 | 70 |
| 270 | 30 |
| 315 | 70 |

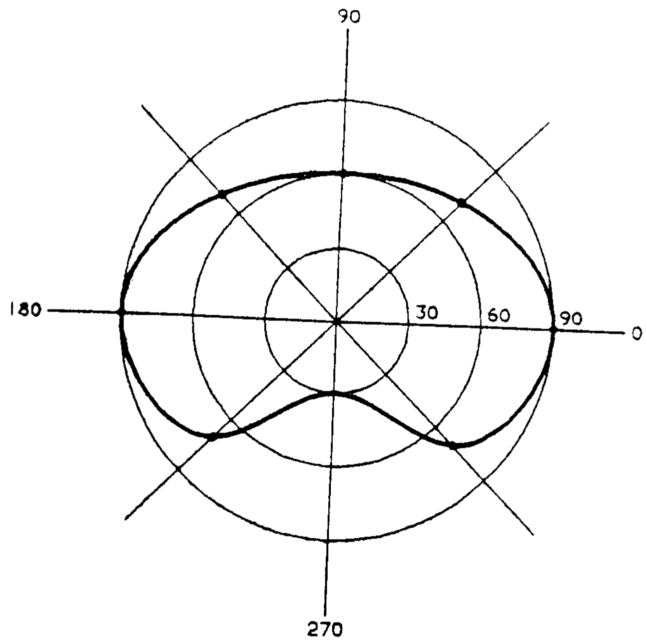



Figure 133. Data Collected in Spherical Angles. This data must be converted to azimuth/elevation angles before it can be entered into the data base.

| AZIMUTH | ELEVATION |
|---|---|
| 90 | 0 |
| 63 | 42 |
| 0 | 60 |
| -63 | 42 |
| -90 | 0 |
| -63 | -42 |
| 0 | -30 |
| 63 | -42 |

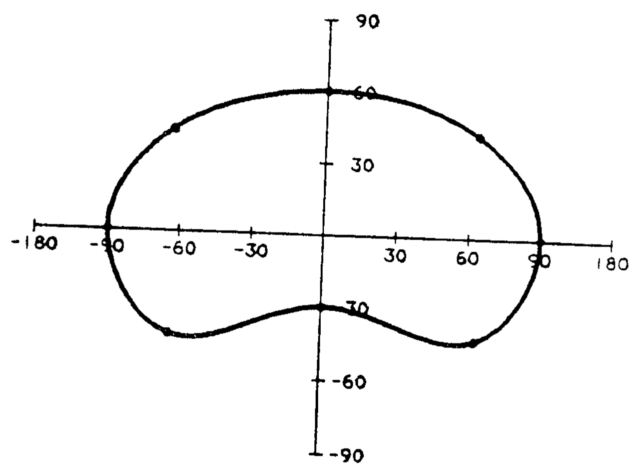



Figure 134. Data Transformed to Azimuth/Elevation Angles.

### 6.3.2 Processing Specification

The available functions are requested using control cards with the format described in Figure 135. The control cards are explained in the following paragraphs.

#### 6.3.2.1 ADD OVERLAY MEMBER Function

The ADD OVERLAY MEMBER function adds the input data under the member name membername to the VISION LIMIT OVERLAY DATA BASE. The membername is limited to a length of 20 characters. The number of pairs is the number of coordinate pairs (X,Y) in the overlay. This value can range between 4 and 100, but a minimum of 8 is recommended. The input format of an add control card is shown in Figure 135. The coordinate pairs (X,Y) are in degrees.

X coordinate point = azimuth angle
Y coordinate point = elevation angle

Azimuth angles left of forward are negative; right, positive. Elevation angles above horizontal are positive; below, negative. The coordinate pairs are formatted by entering X coordinate point and Y coordinate point on the same card. The format for entering the data is shown in Figure 136. The data for creating the EXAMPLE OVERLAY member is shown in Figure 137 and the output that will be produced from the ADD function is shown in Figure 138.

If the program detects an error in the input data the member will not be added to the Data Base.

| A1 | A3 | 1X | A20 | 1X | I3 |
|---|---|---|---|---|---|
| $ | OPR | | Member Name | | Number of Pairs |

Figure 135. Program CBMOM Control Card Format.

| F7.1 | 3X | F7.1 | 3X | |
|---|---|---|---|---|
| Azimuth Angle (X) | | Elevation Angle (Y) | | |

Figure 136. Program CBMOM Data Card Format.

```
$ADD EXAMPLE OVERLAY          008
      90.0         0.0
      63.0        42.0
       0.0        60.0
     -63.0        42.0
     -90.0         0.0
     -63.0       -42.0
       0.0       -30.0
      63.0       -42.0
$END
```

First Area - Control Card.
Second Area - Data Points.

Figure 137. Sample Data for $ADD MEMBER Function.

```
CBMOM --- VISION OVERLAY DATA BASE MAINTENANCE PROGRAM

CBM700I $ADD EXAMPLE OVERLAY
CBM710I $ADD  NAME :EXAMPLE OVERLAY      NUMBER OF POINTS =  8

X COORDINATE POINTS      Y COORDINATE POINTS
        90.0                      0.0
        63.0                     42.0
         0.0                     60.0
       -63.0                     42.0
       -90.0                      0.0
       -63.0                    -42.0
         0.0                    -30.0
        63.0                    -42.0
```

Figure 138. Sample Output for $ADD MEMBER Function.

6.3.2.2 CHECK OVERLAY MEMBER Function

$CHK membername

The CHECK OVERLAY MEMBER function operates in the same way the ADD OVERLAY MEMBER function does except that the member is not added, but is only checked for errors.

6.3.2.3 DELETE OVERLAY MEMBER Function

&DEL membername

The DELETE OVERLAY MEMBER function removes a given membername from the Data Base.

6.3.2.4 DUMP OVERLAY MEMBER Function

&DMP

The DUMP OVERLAY MEMBER function prints the contents of VISION OVERLAY DATA BASE.

6.3.2.5 PRINT OVERLAY MEMBER Function

&PRT membername or
&PRT

The PRINT OVERLAY MEMBER function prints the data contained in the specified membername in a format similar to the input to the ADD OVERLAY MEMBER function. Specifying no name or a nonexistent name causes a printout of the list of members names in the directory.

6.3.2.6 INITIALIZE OVERLAY DATA BASE Function

&INT

The INITIALIZE OVERLAY MEMBER function is used primarily to establish a Data Base, although it may be used to return the data base to its original unused state.

6.3.2.7 END PROGRAM Function

&END

The END PROGRAM function terminates execution of the program CBMOM.

### 6.3.3 Executing CBMOM Program

The sequence of Job Control Language (JCL) cards needed to execute the program CBMOM are shown in Figure 139. Initialization of the Data Base for the first time requires allocation of space on disk for the Data Base and is accomplished by the "//FT09F001 DD" cards shown in Figure 140 and the $INT control card initializes the Data Base. The "//FT01F001 DD" card in Figure 139 is used for all subsequent processing requests. The &END control card is always the last control card and it ends the program CBMOM.

```
//CBMODM    JOB HESS
/*
//JOBLIB     DD  DSN=COMBIMAN.LOADLIB,DISP=SHR
//CBMODM   EXEC  PGM=CBMODM
/*
//SYSPRINT  DD  SYSOUT=A
//FT01F001  DD  DSN=COMBIMAN.OVERLAY.BASE,DISP=SHR
//FT05F001  DD  DSN=SYSIN
//FT06F001  DD  SYSOUT=A
//SYSIN     DD  *

CBMOM FUNCTION CONTROL CARDS AND
MEMBER DEFINITION DATA

/*
//
```

Figure 139. Job Control Cards to Execute CBMOM.

```
//FT01F001 DD   DSN=COMBIMAN.OVERLAY.BASE.DISP=(NEW,CATLG,DELETE),
//              SPACE=(800.16).UNIT=SYSDA
```

Figure 140. FT01001 DD Card to Allocate Space for COMBIMAN.OVERLAY.FILE.

## 6.4 PROGRAM MESSAGES - INCLUDING ERROR CORRECTION

The program CBMOM prints out information and action related messages. The message format is:

CBM7nni message text

where:

| | |
|---|---|
| i | indicates the action code (I=Informational, A=Action to be performed) |
| nn | is the message number |
| message text | is the text of the message. |

CBM700I control card image.

Reason: User has submitted a control card.
System Action: Reads the control card.
User Action: None.

CBM701A operation UNKNOWN OPERATION.

Reason: The operation on the control card (shown in the previous CBM500I message) is unknown.
System Action: This control card is ignored.
User Action: Correct the card and resubmit.

CBM702A NO NAME GIVEN, operation IGNORED.

Reason: This operation requires a member name, but none was supplied.
System Action: The operation is ignored.
User Action: Supply the member name and resubmit.

CBM703A NUMBER OF DATA POINTS IS NOT WITHIN RANGE.

Reason: The number of data points is less than 4 or greater than 100.
System Action: The member will not be added to Data Base.
User Action: Either reduce or increase number of data points.

CBM706A DIRECTORY IS FULL, CANNOT ADD membername.

| | | |
|---|---|---|
| | Reason: | No space is left in the VISION OVERLAY Data Base directory to add an entry for this member. The directory can hold only 15 membernames. |
| | System Action: | The control card is ignored. |
| | User Action: | Delete one or more members, compress the Data Base, and resubmit. |

CBM707A membername ALREADY EXISTS.

| | | |
|---|---|---|
| | Reason: | User has tried to add a member definition under a name that exists in the Data Base. |
| | System Action: | The control card is ignored. |
| | User Action: | Use a new name, and resubmit. |

CBM708I MEMBER membername CHECKED, nn ERRORS.

| | | |
|---|---|---|
| | Reason: | During &CHK, the system found nn errors. |
| | System Action: | Reads next control card. |
| | User Action: | Correct and resubmit. |

CBM709I membername NOT ADDED DUE TO nn ERRORS.

| | | |
|---|---|---|
| | Reason: | During &ADD operation, the system found nn errors. |
| | System Action: | Reads next control card; member is not added. |
| | User Action: | Correct error(s) and resubmit. |

CBM710I Add membername with n points.

| | | |
|---|---|---|
| | Reason: | Information on add operator. |
| | System Action: | Program continues. |
| | User Action: | None. |

CBM711A membername NOT FOUND.

| | | |
|---|---|---|
| | Reason: | For the Delete function (&DEL) or Print function (&PRT) the specified visibility member name does not exist. |
| | System Action: | The directory of the visibility data base is printed, instead of performing the requested function. |
| | User Action: | Check the control card for nonexistent membername. |

CBM712I membername DELETED.

| | |
|---|---|
| Reason: | The user submitted a DELETE function control card (&DEL). |
| System Action: | The membername is deleted. |
| User Action: | None. |

CBM713I INITIALIZED.

| | |
|---|---|
| Reason: | The user requested that the Visibility Data Base be initialized using the INITIALIZE VISIBILITY DATA BASE Function (&INT). |
| System Action: | The Data Base is initialized. |
| User Action: | None. |

CBM714I PROGRAM END.

| | |
|---|---|
| Reason: | The END PROGRAM function control (&END) card was executed. |
| System Action: | Terminates program. |
| User Action: | Make sure that all control cards are accepted, and processed correctly. |

CBM715A DATA BASE IS NOT VISIBILITY DATA BASE.

| | |
|---|---|
| Reason: | First record in directory contains a keyword 'OVER' to identify a Visibility Data Base. We accessed a data set without that keyword. |
| System Action: | Terminates program. |
| User Action: | Check JCL cards and access correct data set. |

CBM716A END OF DATA.

| | |
|---|---|
| Reason: | The end of file was found before the END Program control card (&END). |
| System Action: | The program is ended. |
| User Action: | Check to make sure that all the control cards are processed. |

CBM717A I/O ERROR ON RECORD recordnumber (INDEX).

| | |
|---|---|
| Reason: | An I/O error occurred on the Visibility Data Base. |
| System Action: | Terminates the program. |
| User Action: | Contact Systems Programmer. |

CBM718A I/O ERROR ON RECORD recordnumber (DATA).

| | |
|---|---|
| Reason: | An I/O error occurred on the Visibility Data Base. |
| System Action: | Terminates the program. |
| User Action: | Contact Systems Programmer. |

CBM719I PROGRAM ABENDED.

| | |
|---|---|
| Reason: | Program could not recover from an error. |
| System Action: | Terminates the program. |
| User Action: | None. |

APPENDIX A

# COMBIMAN DISTRIBUTION TAPE

## COMBIMAN VERSION 7 - MARCH 22, 1985

## A. CONTENTS

The COMBIMAN distribution tape is an IBM standard-label, nine track, parity=odd, magnetic tape containing 14 sequential data sets and three partitioned data sets. The tape density is either 1600 bpi or 6250 bpi. Check the label on the tape reel to find out which density you have. The tape was created using the IBM IEHMOVE MVS utility. The volume name for the tape is "CBMTPE". The file names and their data control block parameters are described in the following table.

| DATA SET NAME | FILE | LRECL | RECFM | BLKSIZE | ORGANIZATION |
|---|---|---|---|---|---|
| COMBIMAN.TAPEDOC | 1 | 80 | FB | 6160 | SEQUENTIAL |
| COMBIMAN.INSTLJCL | 2 | 80 | FB | 6160 | SEQUENTIAL |
| COMBIMAN.LOADLIB | 3 | | U | 6160 | PARTITIONED |
| COMBIMAN.ANTHDATA | 4 | 248 | FB | 248 | SEQUENTIAL |
| COMBIMAN.CRSTDATA | 5 | 368 | FB | 368 | SEQUENTIAL |
| COMBIMAN.CRSTDAT1 | 6 | 624 | FB | 624 | SEQUENTIAL |
| COMBIMAN.INITNEW | 7 | 150 | VBS | 6160 | SEQUENTIAL |
| COMBIMAN.SMPLANTH | 8 | 80 | FB | 6160 | SEQUENTIAL |
| COMBIMAN.OVERLAY.DATA | 9 | 240 | FB | 240 | SEQUENTIAL |
| COMBIMAN.STRENGTH | 10 | 248 | FB | 248 | SEQUENTIAL |
| COMBIMAN.RCHDATA | 11 | 432 | FB | 432 | SEQUENTIAL |
| COMBIMAN.PRODNJCL | 12 | 80 | FB | 6160 | PARTITIONED |
| COMBIMAN.DBDATA | 13 | 80 | FB | 6160 | PARTITIONED |
| COMBIMAN.HEAD.DATA | 14 | 80 | FB | 4240 | SEQUENTIAL |
| COMBIMAN.HAND.DATA | 15 | 80 | FB | 4240 | SEQUENTIAL |
| COMBIMAN.BOOT.DATA | 16 | 80 | FB | 4240 | SEQUENTIAL |
| COMBIMAN.HELMET.DATA | 17 | 80 | FB | 4240 | SEQUENTIAL |
| COMBIMAN.PLOTDATA | NA | 80 | FB | 6160 | SEQUENTIAL |

A brief description of the tape files and their contents follows:

File 1: COMBIMAN.TAPEDOC
The first file is a copy of the text in this appendix, describing the contents of the distribution tape and installation instructions.

File 2: COMBIMAN.INSTLJCL

The second file is a generic job control language file. It contains directives to initialize and catalog disk files needed for COMBIMAN execution. It also contains directives for copying files 3 through 13 from the tape to disk. You can modify this file to make it specific for your system, then use that JCL to intialize and copy the COMBIMAN files from the distribution tape.

File 3: COMBIMAN.LOADLIB

This partitioned data set is the COMBIMAN load library. It contains executable versions of the COMBIMAN programs. The members of the file are as follows:

CBMAM
CBMCM
CBMCM2
CBMODM
CBM07
CBM7NOPL

These programs are described in the following sections or elsewhere in the User's Guide. Link maps of the programs above (except CBM7NOPL, which is essentially identical to CBM07) are included in Appendix B of the User's Guide.

File 4: COMBIMAN.ANTHDATA

This contains anthropometric survey data and regression data for the following surveys: 1967 USAF Pilots; 1968 USAF Women; 1968 USAF Woman Fliers; 1964 US Navy Fliers; 1970 US Army Pilots; and 1977 US Army Women. The file is used with the COMBIMAN programs CBM07 and CBM7NOPL. A similar file can be created using the anthropometry data base maintenance program CBMAM. Job control language and sample data for using CBMAM are described in Appendix C of the User's Guide.

File 5: COMBIMAN.CRSTDATA

This file contains crew station data for use with the COMBIMAN programs CBM07 and CBM7NOPL. The file was created using the crew station data base maintenance program CBMCM. The file contains data for an A7E-01 crew station, and a pilot seat for the A7. Job control language and sample data for creating a similar file using CBMCM are described in Appendix C of the User's Guide.

File 6: COMBIMAN.CRSTDAT1
This file contains crew station data for use with the COMBIMAN programs CBM07 and CBM7NOPL. The file was created using the enhanced crew station data base maintenance program CBMCM2. The file contains data for an A7E-01 crew station, and a pilot seat for the A7. Job control language and sample data for creating a similar file using CBMCM2 are described in Appendix C of the User's Guide.

File 7: COMBIMAN.INITNEW
This file contains some initialization values used with the COMBIMAN programs CBM07 and CBM7NOPL. Included in the data are the COMBIMAN link system definitions and prompting messages. Note that this file contains data necessary for use with the expanded COMBIMAN link system used in Version 7 of the programs, and that use of pre-Version 7 copies of this file with CBM07 or CBM7NOPL may produce erroneous results. This file is not user-modifiable.

File 8: COMBIMAN.SMPLANTH
This file contains sample anthropometry for use with the COMBIMAN programs CBM07 and CBM7NOPL. In those programs, the data is used in conjunction with the ANTHROPOMETRIC DIMENSIONS programmed function key (PFK12), under the card-input option of that function. See the section of the User's Guide which describes that function key for details on modifying this file.

File 9: COMBIMAN.OVERLAY.DATA
This file contains visibility overlay data for the baseline visibility contour, as well as the standard Air Force helmet/oxygen mask combination visibility contour. The file is used by the COMBIMAN programs CBM07 and CBM7NOPL. It was created using the visibility data base maintenance program CBMVM. Job control language and sample data for creating a similar file are described in Appendix C.

File 10: COMBIMAN.STRENGTH.DATA
This file contains human strength data for use with the COMBIMAN programs CBM07 and CBM7NOPL, in conjunction with the STRENGTH ANALYSIS functions of those programs. The file is not user-modifiable.

File 11: COMBIMAN.RCHDATA

This file contains reach data used by the COMBIMAN programs CBM07 and CBM7NOPL. The data is used in conjunction with the REACH CURVE analysis functions of those programs. The file is not user-modifiable.

File 12: COMBIMAN.PRODNJCL

This partitioned data set contains sample production job control language for use with the COMBIMAN programs. These will probably have to be modified to be useful on your system. Text of the members of this file is shown in Appendix C. The members of this file are named for the COMBIMAN programs which they execute. The members of the file are as follows:

CBMAM
CBMCM
CBMCM2
CBMODM
CBM07
CBM7NOPL

File 13: COMBIMAN.DBDATA

This partitioned data set contains sample data for use with the COMBIMAN data base maintenance programs. Text of the members of this file is shown in Appendix C. The members of this file are named to correspond to the names of the maintenance programs with which they are used. The members of the file are as follows:

CBMAM
CBMCM
CBMCM2
CBMODM

Files 14, 15, 16 and 17 contain data necessary for the graphical depiction of COMBIMAN, in both CBM07 and CBM7NOPL. These Files are not user-modified.

| | |
|---|---|
| File 14: | COMBIMAN.HEAD.DATA |
| File 15: | COMBIMAN.HAND.DATA |
| File 16: | COMBIMAN.BOOT.DATA |
| File 17: | COMBIMAN.HELMET.DATA |

One file is listed in the table above but is not on the distribution tape: COMBIMAN.PLOTDATA. This will need to be initialized and cataloged on your system. The file is used for off-line plotting functions by the programs CBM07 and CBM7NOPL.

B. SYSTEM CONSIDERATIONS

At the HESS Computer Facility, the COMBIMAN programs currently run on an IBM 3031 computer, under the OS/VS2 MVS (System 370) operating system. The graphics programs are written in the FORTRAN IV and Assembler languages, and use the IBM Graphics Subroutine Package (also known as the Graphics Access Method: GSP/GAM) to drive the graphics devices. The graphics devices used in this environment currently are Adage 4370 display devices, which emulate IBM 3250 display devices. The Adage devices are currently configured to provide 32 kbytes of buffer memory per display, as defined in the system generation scheme (SYSGEN). It probably is not necessary for the devices on your system to be configured with that much buffer memory to allow the COMBIMAN programs to function correctly. Buffer memory set at 16 kbytes should be sufficient for use with the programs.

Note from the link map of CBM07 that the program uses the GSP/GAM routines IHCGSP01, IHCGSP02, IHCGSP03 and IHCGSP04. This may have some significance on your system, particularly with regard to the IHCGSP04 routine. You may wish to consult with your system management personnel to see if these routines are available on your system. (However, if there other programs being run on your display devices, the routines are probably available on your system).

With regard to SYSGEN parameters, the system should be configured to include all graphics. Also, under the MVS operating system, the following system routines should be included in the system "Fix List" to keep them resident on the system during program execution:

IFFAFA05 (6816 RCT INIT/TERM)
IFFAFA17 (6384 PROGRAM FETCH)
IFFAFA12 (FETCH ALIAS)
IFFAFA06 (5072 PURGE - SVC16)
IFFAFA04
IFFAEA07 (368 RESTORE - SVC17)

You should consult with your system management personnel about these and the above considerations. Again, if your system currently runs programs using the GSP/GAM routines, these problems should already be solved.

Your system may use, instead of the GSP/GAM package, a newer IBM product called the Graphics Access Method/System Product, Release 2 (GAM/SP R2). This was released in about June of 1984, and provides support for the "full range of functions provided by the 5080 graphics system", according to IBM. Additionally, the package provides support for both the MVS/370

and the MVS/XA operating systems. IBM reports that GSP/GAM and GSP/SP R2 cannot coexist on the same system, so your system will have one or the other available. We currently have no experience with running the COMBIMAN programs on a system using GAM/SP R2 or later releases, since the COMBIMAN programs have no need for the additional capabilities available with GAM/SP R2. However, IBM reports that GAM/SP R2 provides support for the 3250 and 2250-3 display devices that is "generally compatible with the programming support currently available" with GSP/GAM. That is, the COMBIMAN programs probably can work in a system environment which uses GAM/SP R2.

At the HESS Computer Facility, the COMBIMAN program CBM07 is typically run with a Versatec plotter allocated to the job. This is for use with the on-line plotting functions of the program. Many system installations are not configured to permit this type of allocation. In these cases, the COMBIMAN program must be run without the on-line plotting capabilities present. There are two ways to accomplish this.

First, if you wish to use the program CBM07, you must change the data definition statement which allocates the plotter in your job control language file (see Appendix C of the User's Guide). That is, instead of the statement:

```
//SYSVECTR  DD  UNIT=OEE, ...
```

you must include the statement:

```
//SYSVECTR  DD  DUMMY, ...
```

in your JCL stream. The program will work as usual, except that it may terminate abnormally if the on-line plotting keys of the programmed function keyboard (ON-LINE PLOT; DUMP CRT) are accidentally pressed.

An alternate, and probably better solution is to use the program CBM7NOPL, which has been included as a member of the COMBIMAN load library. This is an almost identical, but non-plotting, version of the program CBM07. The program functions the same as CBM07, except that while the on-line program function keys are lit during execution, they have been rendered inactive. The program will not abnormally terminate if these keys are accidentally pressed. Note that to get on-line plotting, you must still use the program CBM07, with a plotter properly allocated.

See Appendix C of the User's Guide for sample job control language to run the programs CBM07 and CBM7NOPL.

## C. INSTALLATION PROCEDURES

To install files from the COMBIMAN distribution tape, you will have to run two batch jobs using the tape.

The first job will copy the first two files from the tape to disk. You will have to create your own job control language file to run this job; the necessary JCL is described in the following paragraphs. The second job will allocate and catalog disk files which will be needed by the COMBIMAN programs (using the IBM utility program IEFBR14), and then will copy the remaining tape files into these new disk files (using the IBM utility program IEHMOVE).

Use the IBM utility program IEBGENER to copy the first two files from the COMBIMAN distribution tape. The first file is the text contained in this appendix. The second file is sample job control language to copy the remaining files from tape to disk. Sample job control language to copy the first two files is as shown in Figure A-1.

Once you have copied the second tape file to disk, you will have to modify it to make it conform to your system. Instructions for making those modifications are included as comments in that file. After the modifications have been made to the JCL in File 2, submit that as the second batch job. File 3 through File 17 will then be copied from tape onto disk. (Figure A-2)

Note that while all sample job control language shown in this appendix refers to a single disk pack, it is not necessary that all the COMBIMAN files be stored on a single pack.

The DCB parameters for all the tape files are given at the table in Section A of this appendix. The space parameters for the data sets are given below, assuming a 3350-type disk drive:

| DATA SET NAME | SPACE PARAMETERS |
|---|---|
| COMBIMAN.TAPEDOC | (TRK,(5,1)) |
| COMBIMAN.INSTLJCL | (TRK,(1,1)) |
| COMBIMAN.LOADLIB | (TRK,(100,20,5)) |
| COMBIMAN.ANTHDATA | (TRK,(50,10)) |
| COMBIMAN.CRSTDATA | (TRK,(60,10)) |

```
COMBIMAN.CRSTDAT1        (TRK,(100,10))
COMBIMAN.INITNEW         (TRK,(2,1))
COMBIMAN.SMPLANTH        (TRK,(2,1))
COMBIMAN.VISBDATA        (TRK,(35,5))
COMBIMAN.STRENGTH        (TRK,(40,10))

COMBIMAN.RCHDATA         (TRK,(3,1))
COMBIMAN.PRODNJCL        (TRK,(2,1,5))
COMBIMAN.DBDATA          (TRK,(10,2,5))
COMBIMAN.PLOTDATA        (TRK,(1,1))

COMBIMAN.HEAD.DATA       (TRK(2,1), RLSE)
COMBIMAN.HAND.DATA       (TRK(2,1), RLSE)
COMBIMAN.BOOT.DATA       (TRK(2,1), RLSE)
COMBIMAN.HELMET.DATA     (TRK(2,1), RLSE)
```

```
//COMBIMAN  JOB CBM,CLASS=A,MSGCLASS=A,
//     TIME=(2,0)
//*
//*
//*
//*-------------------------------------------------------------
//*- COMBIMAN INSTALLATION JOB CONTROL FILE                     -
//*- --------------------------------------                     -
//*-                                                           -
//*- PART A. IEBGENER COPIES FROM TAPE.                         -
//*-                                                           -
//*- STEP 1. COMBIMAN TAPE DOCUMENTATION COPY.                  -
//*-                                                           -
//*- THIS WILL COPY AND CATALOG THE COMBIMAN TAPE               -
//*- DOCUMENTATION FILE.                                        -
//*-                                                           -
//*- STEP 2. COMBIMAN INSTALLATION JCL COPY.                    -
//*-                                                           -
//*- THIS STEP WILL COPY AND CATALOG THE COMBIMAN               -
//*- INSTALLATION JCL FILE FROM THE DISTRIBUTION TAPE.  YOU     -
//*- WILL HAVE TO MODIFY THE INSTALLATION JCL FILE TO MAKE      -
//*- IT CONFORM TO YOUR SYSTEM.  INSTRUCTIONS FOR MAKING THE    -
//*- MODIFICATIONS ARE INCLUDED AS COMMENTS IN THAT FILE.       -
//*-                                                           -
//*- THESE COPY STEPS ASSUME THE FOLLOWING:                     -
//*-                                                           -
//*- A. FILES WILL BE STORED ON A DISK PACK WITH VOLUME NAME    -
//*-    'CBMDSK';                                              -
//*- B. THE DISK IS AN IBM 3350 DEVICE TYPE WITH 19069 BYTES    -
//*-    PER TRACK.                                             -
//*-                                                           -
//*- YOU WILL HAVE TO CHANGE THE JCL SHOWN IN THESE STEPS TO    -
//*- CONFORM TO YOUR SYSTEM AS FOLLOWS:                         -
//*-                                                           -
//*- A. CHANGE TRACK SIZES ON SPACE PARAMETERS BELOW IF YOUR    -
//*-    SYSTEM USES A DEVICE TYPE OTHER THAN 3350 (MULTIPLY     -
//*-    SPACE BY 1.5 IF GOING TO 3330 DISKS; DIVIDE BY 2.3      -
//*-    IF GOING TO 3380 DISKS - MINIMUM TRACK SIZE OF 1);      -
//*- B. CHANGE THE AS-SHOWN 'VOL=SER=CBMDSK' TO THE DEVICE      -
//*-    NAME YOU WILL BE USING ON YOUR SYSTEM.                  -
//*-                                                           -
//*- NOTE: IT IS NOT NECESSARY FOR ALL COMBIMAN FILES TO BE     -
//*-       STORED ON THE SAME DISK PACK.                        -
//*-                                                           -
//*-------------------------------------------------------------
//*
```

Figure A-1. Sample Job Control Language (JCL) to Copy First Two Files.

```
//* STEP 1 - COMBIMAN TAPE DOCUMENTATION COPY
//* ------------------------------------------
//*
//STEP1   EXEC PGM=IEBGENER
//*
//SYSPRINT DD SYSOUT=A
//SYSIN    DD DUMMY
//SYSUT1   DD DSN=COMBIMAN.TAPEDOC,
//            UNIT=TAPE,VOL=(,RETAIN,SER=CBMTPE),
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160),
//            DISP=OLD,LABEL=(1,SL)
//*
//SYSUT2   DD DSN=COMBIMAN.TAPEDOC,
//            DISP=(NEW,CATLG),
//            UNIT=SYSDA,
//            VOL=SER=CBMDSK,
//            SPACE=(TRK,(5,1),RLSE),
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160)
//*
//* STEP 2 - COMBIMAN INSTALLATION JCL FILE COPY
//* --------------------------------------------
//*
//STEP2   EXEC PGM=IEBGENER
//*
//SYSPRINT DD SYSOUT=A
//SYSIN    DD DUMMY
//SYSUT1   DD DSN=COMBIMAN.INSTLJCL,
//            UNIT=TAPE,VOL=(,RETAIN,SER=CBMTPE),
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160),
//            DISP=OLD,LABEL=(2,SL)
//*
//SYSUT2   DD DSN=COMBIMAN.INSTLJCL,
//            DISP=(NEW,CATLG),
//            UNIT=SYSDA,
//            VOL=SER=CBMDSK,
//            SPACE=(TRK,(1,1),RLSE),
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160)
//*
```

Figure A-1. Sample Job Control Language (JCL) to Copy First Two Files. (Continued)

```
//COMBIMAN JOB  CBM,CLASS=A,MSGCLASS=A,
//     TIME=(2,0)
//*
//* ----------------------------------------------------------------------
//* - COMBIMAN INSTALLATION JOB CONTROL FILE                                 -
//* - VERSION 7 - 10/85 -                                                    -
//* - --------------------------------------                                 -
//* -                                                                        -
//* - PART B. FILE INITIALIZATIONS AND COPIES FROM TAPE.                     -
//* -                                                                        -
//* - STEP 3. COMBIMAN DATA SET INITIALIZATION.                              -
//* -         THIS WILL CREATE AND CATALOG FILES NEEDED BY THE               -
//* -         COMBIMAN EXECUTION JOBS.                                       -
//* -                                                                        -
//* - STEP 4. COMBIMAN TAPE MOVE STEP.                                       -
//* -         THIS STEP WILL COPY COMBIMAN FILES FROM THE COMBIMAN           -
//* -         DISTRIBUTION TAPE USING THE IBM MVS UTILITY IEHMOVE.           -
//* -         THE FILES WILL BE COPIED INTO FILES WHICH WERE CREATED         -
//* -         AND CATALOGED IN THE PREVIOUS STEP.  NOTE THAT IEHMOVE         -
//* -         COULD ALSO BE USED TO ALLOCATE THE DISK FILES, BUT THAT        -
//* -         IT MAY NOT ALLOCATE THE CORRECT AMOUNT OF SPACE NEEDED         -
//* -         FOR THESE FILES.                                               -
//* -                                                                        -
//* ----------------------------------------------------------------------
//* -                                                                        -
//* -                                                                        -
//* ----------------------------------------------------------------------
//* - STEP 3. COMBIMAN DATA SET INITIALIZATION.                              -
//* -         THIS WILL CREATE AND CATALOG FILES NEEDED BY THE               -
//* -         COMBIMAN EXECUTION JOBS.                                       -
//* -                                                                        -
//* -         THIS INITIALIZATION STEP ASSUMES THE FOLLOWING:                -
//* -      A. FILES WILL BE STORED ON A DISK PACK WITH VOLUME NAME           -
//* -         'CBMDSK';                                                      -
//* -      B. THE DISK IS AN IBM 3350 DEVICE TYPE WITH 19069 BYTES           -
//* -         PER TRACK.                                                     -
//* -                                                                        -
//* -         YOU WILL HAVE TO CHANGE THE JCL SHOWN IN THIS STEP TO          -
//* -         CONFORM TO YOUR SYSTEM AS FOLLOWS:                             -
//* -      A. CHANGE TRACK SIZES ON SPACE PARAMETERS BELOW IF YOUR           -
//* -         SYSTEM USES A DEVICE TYPE OTHER THAN 3350 (MULTIPLY            -
//* -         SPACE BY 1.6 IF GOING TO 3330 DISKS; DIVIDE BY 2.3 IF          -
//* -         GOING TO 3380 DISKS);                                          -
//* -      B. CHANGE THE AS-SHOWN 'VOL=SER=CBMDSK' TO THE DEVICE NAME        -
//* -         YOU WILL BE USING ON YOUR SYSTEM.                              -
//* -                                                                        -
//* -         NOTE: IT IS NOT NECESSARY FOR ALL COMBIMAN FILES TO BE         -
//* -         STORED ON THE SAME DISK PACK.                                  -
//* -                                                                        -
//* ----------------------------------------------------------------------
//*
```

Figure A-2. Distribution Tape File COMBIMAN.INSTLJCL: Job Control Language to Initialize Files and Copy File 3 through File 17 from the Distribution Tape.

```
//* STEP3 - ALLOCATION
//* -----------------
//*
//STEP3  EXEC PGM=IEFBR14
//*
//FILEAA DD DSN=COMBIMAN.PLOTDATA,
//          UNIT=SYSDA,
//          VOL=SER=CBMDSK,
//          DISP=(NEW,CATLG),
//          SPACE=(TRK,(2,2)),
//          DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160)
//*
//FILE03 DD DSN=COMBIMAN.LOADLIB,
//          UNIT=SYSDA,
//          VOL=SER=CBMDSK,
//          DISP=(NEW,CATLG),
//          SPACE=(TRK,(100,20,25)),
//          DCB=(RECFM=U,LRECL=0,BLKSIZE=6160)
//*
//FILE04 DD DSN=COMBIMAN.ANTHDATA,
//          UNIT=SYSDA,
//          VOL=SER=CBMDSK,
//          DISP=(NEW,CATLG),
//          SPACE=(TRK,(50,10)),
//          DCB=(RECFM=FB,LRECL=248,BLKSIZE=248)
//*
//FILE05 DD DSN=COMBIMAN.CRSTDATA,
//          UNIT=SYSDA,
//          VOL=SER=CBMDSK,
//          DISP=(NEW,CATLG),
//          SPACE=(TRK,(60,10)),
//          DCB=(RECFM=FB,LRECL=368,BLKSIZE=368)
//*
//FILE06 DD DSN=COMBIMAN.CRSTDAT1,
//          UNIT=SYSDA,
//          VOL=SER=CBMDSK,
//          DISP=(NEW,CATLG),
//          SPACE=(TRK,(100,10)),
//          DCB=(RECFM=FB,LRECL=624,BLKSIZE=624)
//*
//FILE07 DD DSN=COMBIMAN.INITNEW,
//          UNIT=SYSDA,
//          VOL=SER=CBMDSK,
//          DISP=(NEW,CATLG),
//          SPACE=(TRK,(2,1)),
//          DCB=(RECFM=VBS,LRECL=150,BLKSIZE=6160)
//*
//FILE08 DD DSN=COMBIMAN.SMPLANTH,
//          UNIT=SYSDA,
//          VOL=SER=CBMDSK,
//          DISP=(NEW,CATLG),
//          SPACE=(TRK,(2,1)),
//          DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160)
//*
```

Figure A-2. Distribution Tape File COMBIMAN.INSTLJCL: Job Control Language to Initialize Files and Copy File 3 through File 17 from the Distribution Tape. (Continued)

```
//FILE09 DD DSN=COMBIMAN.OVERLAY.DATA,
//          UNIT=SYSDA,
//          VOL=SER=CBMDSK,
//          DISP=(NEW,CATLG),
//          SPACE=(TRK,(1,0)),
//          DCB=(RECFM=F,LRECL=0,BLKSIZE=800)
//*
//FILE10 DD DSN=COMBIMAN.STRENGTH.DATA,
//          UNIT=SYSDA,
//          VOL=SER=CBMDSK,
//          DISP=(NEW,CATLG),
//          SPACE=(TRK,(40,10)),
//          DCB=(RECFM=F,LRECL=248,BLKSIZE=248)
//*
//FILE11 DD DSN=COMBIMAN.RCHDATA,
//          UNIT=SYSDA,
//          VOL=SER=CBMDSK,
//          DISP=(NEW,CATLG),
//          SPACE=(TRK,(3,1)),
//          DCB=(RECFM=F,LRECL=432,BLKSIZE=432)
//*
//FILE12 DD DSN=COMBIMAN.PRODNJCL,
//          UNIT=SYSDA,
//          VOL=SER=CBMDSK,
//          DISP=(NEW,CATLG),
//          SPACE=(TRK,(1,1,5)),
//          DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160)
//*
//FILE13 DD DSN=COMBIMAN.DBDATA,
//          UNIT=SYSDA,
//          VOL=SER=CBMDSK,
//          DISP=(NEW,CATLG),
//          SPACE=(TRK,(10,2,5)),
//          DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160)
//*
//FILE14 DD DSN=COMBIMAN.HEAD.DATA,
//          UNIT=SYSDA,
//          VOL=SER=CBMDSK,
//          DISP=(NEW,CATLG),
//          SPACE=(TRK,(2,1),RLSE),
//          DCB=(RECFM=FB,LRECL=80,,BLKSIZE=4240)
//*
//FILE15 DD DSN=COMBIMAN.HAND.DATA,
//          UNIT=SYSDA,
//          VOL=SER=CBMDSK,
//          DISP=(NEW,CATLG),
//          SPACE=(TRK,(2,1),RLSE),
//          DCB=(RECFM=FB,LRECL=80,BLKSIZE=4240)
//*
//FILE16 DD DSN=COMBIMAN.BOOT.DATA,
//          UNIT=SYSDA,
//          VOL=SER=CBMDSK,
//          DISP=(NEW,CATLG),
//          SPACE=(TRK,(2,1),RLSE),
//          DCB=(RECFM=FB,LRECL=80,BLKSIZE=4240)
//*
//FILE17 DD DSN=COMBIMAN.HELMET.DATA,
//          UNIT=SYSDA,
//          VOL=SER=CBMDSK,
//          DISP=(NEW,CATLG),
//          SPACE=(TRK,(2,1),RLSE),
//          DCB=(RECFM=FB,LRECL=80,BLKSIZE=4240)
//* ------------------------------------------------------------------
```

Figure A-2. Distribution Tape File COMBIMAN.INSTLJCL: Job Control Language to Initialize Files and Copy File 3 through File 17 from the Distribution Tape. (Continued)

```
//* - STEP 4. COMBIMAN TAPE MOVE STEP.                                    -
//* -          THIS STEP WILL COPY COMBIMAN FILES FROM THE COMBIMAN      -
//* -          DISTRIBUTION TAPE USING THE IBM MVS UTILITY IEHMOVE.      -
//* -          THE FILES WILL BE COPIED INTO FILES WHICH WERE CREATED    -
//* -          AND CATALOGED IN THE PREVIOUS STEP.  NOTE THAT IEHMOVE    -
//* -          COULD ALSO BE USED TO ALLOCATE THE DISK FILES, BUT THAT   -
//* -          IT MAY NOT ALLOCATE THE CORRECT AMOUNT OF SPACE NEEDED    -
//* -          FOR THESE FILES.                                          -
//* -                                                                    -
//* -          YOU WILL HAVE TO CHANGE THE JCL SHOWN IN THIS PART TO     -
//* -          CONFORM TO YOUR SYSTEM AS FOLLOWS:                        -
//* -       A. CHANGE THE AS-SHOWN 'VOL=SER=CBMDSK' TO THE DEVICE NAME   -
//* -          YOU WILL BE USING ON YOUR SYSTEM;                         -
//* -       B. CHANGE THE AS-SHOWN 'TO=SYSDA=CBMDSK' TO THE DEVICE       -
//* -          NAME YOU WILL BE USING ON YOUR SYSTEM.                    -
//* -                                                                    -
//* -          NOTE: 'RENAME' PARAMETERS ARE SHOWN AS IEHMOVE INPUT      -
//* -          OPTIONS IN THIS STEP.  THESE ARE NOT NECESSARY IF YOUR    -
//* -          FILES WILL NOT BE RENAMED WHEN THEY ARE COPIED (BUT       -
//* -          NOTHING WRONG WILL HAPPEN IF YOU LEAVE THE 'RENAMES'      -
//* -          IN, AND RENAME TO THE SAME FILE NAMES, AS SHOWN HERE).    -
//* -          FOR EXAMPLE PURPOSES, THE 'RENAME' PARAMETERS ARE         -
//* -          INCLUDED IN THIS FILE.  IF YOU DO RENAME YOUR FILES, BE   -
//* -          SURE THAT THE 'RENAME=' DATA SET NAMES CORRESPOND TO      -
//* -          THE NAMES OF THE DATA SETS YOU CREATED IN STEP 3.         -
//* -                                                                    -
//* ---------------------------------------------------------------------
//*
//* STEP 4 - IEHMOVE FILE COPIES
//* ---------------------------
//*
//STEP4    EXEC PGM=IEHMOVE
//*
//SYSPRINT DD SYSOUT=A
//*
//SYSUT1   DD UNIT=SYSDA,SPACE=(TRK,(60))
//*
//TAPEA    DD UNIT=TAPE,DISP=(OLD,PASS),
//            LABEL=(,SL),VOL=SER=CBMTPE
//*
//DISKA    DD UNIT=DISK,DISP=SHR,VOL=SER=CBMDSK
//*
//*......1....V...2.........3.........4.........5.........6.........7..
//SYSIN    DD *
 COPY DSNAME=COMBIMAN.LOADLIB,                                         X
               TO=SYSDA=CBMDSK,                                        X
               FROM=TAPE=(CBMTPE,03),                                  X
               RENAME=COMBIMAN.LOADLIB
 COPY DSNAME=COMBIMAN.ANTHDATA,                                        X
               TO=SYSDA=CBMDSK,                                        X
               FROM=TAPE=(CBMTPE,04),                                  X
               RENAME=COMBIMAN.ANTHDATA
```

Figure A-2. Distribution Tape File COMBIMAN.INSTLJCL: Job Control Language to Initialize Files and Copy File 3 through File 17 from the Distribution Tape. (Continued)

```
COPY DSNAME=COMBIMAN.CRSTDATA,                                         X00002210
                    TO=SYSDA=CBMDSK,                                   X00002220
                    FROM=TAPE=(CBMTPE,05),                             X00002230
                    RENAME=COMBIMAN.CRSTDATA                            00002240
COPY DSNAME=COMBIMAN.CRSTDAT1,                                         X00002250
                    TO=SYSDA=CBMDSK,                                   X00002260
                    FROM=TAPE=(CBMTPE,06),                             X00002270
                    RENAME=COMBIMAN.CRSTDAT1                            00002280
COPY DSNAME=COMBIMAN.INITNEW,                                          X00002290
                    TO=SYSDA=CBMDSK,                                   X00002300
                    FROM=TAPE=(CBMTPE,07),                             X00002310
                    RENAME=COMBIMAN.INITNEW                             00002320
COPY DSNAME=COMBIMAN.SMPLANTH,                                         X00002330
                    TO=SYSDA=CBMDSK,                                   X00002340
                    FROM=TAPE=(CBMTPE,08),                             X00002350
                    RENAME=COMBIMAN.SMPLANTH                            00002360
COPY DSNAME=COMBIMAN.OVERLAY.DATA,                                     X00002370
                    TO=SYSDA=CBMDSK,                                   X00002380
                    FROM=TAPE=(CBMTPE,09),                             X00002390
                    RENAME=COMBIMAN.OVERLAY.DATA                        00002400
COPY DSNAME=COMBIMAN.STRENGTH,                                         X00002410
                    TO=SYSDA=CBMDSK,                                   X00002420
                    FROM=TAPE=(CBMTPE,10),                             X00002430
                    RENAME=COMBIMAN.STRENGTH                            00002440
COPY DSNAME=COMBIMAN.RCHDATA,                                          X00002450
                    TO=SYSDA=CBMDSK,                                   X00002460
                    FROM=TAPE=(CBMTPE,11),                             X00002470
                    RENAME=COMBIMAN.RCHDATA                             00002480
COPY DSNAME=COMBIMAN.PRODNJCL,                                         X00002490
                    TO=SYSDA=CBMDSK,                                   X00002500
                    FROM=TAPE=(CBMTPE,12),                             X00002510
                    RENAME=COMBIMAN.PRODNJCL                            00002520
COPY DSNAME=COMBIMAN.DBDATA,                                           X00002530
                    TO=SYSDA=CBMDSK,                                   X00002540
                    FROM=TAPE=(CBMTPE,13),                             X00002550
                    RENAME=COMBIMAN.DBDATA                              00002560
COPY DSNAME=COMBIMAN.HEAD.DATA,                                        X00002570
                    TO=SYSDA=CBMDSK,                                   X00002580
                    FROM=TAPE=(CBMTPE,14),                             X00002590
                    RENAME=COMBIMAN.HEAD.DATA                           00002600
COPY DSNAME=COMBIMAN.HAND.DATA,                                        X00002610
                    TO=SYSDA=CBMDSK,                                   X00002620
                    FROM=TAPE=(CBMTPE,15)                              X00002630
                    RENAME=COMBIMAN.HAND.DATA                           00002640
COPY DSNAME=COMBIMAN.BOOT.DATA,                                        X00002650
                    TO=SYSDA=CBMDSK,                                   X00002660
                    FROM=TAPE=(CBMTPE,16),                             X00002670
                    RENAME=COMBIMAN.BOOT.DATA                           00002680
COPY DSNAME=COMBIMAN.HELMET.DATA,                                      X00002690
                    TO=SYSDA=CBMDSK,                                   X00002700
                    FROM=TAPE=(CBMTPE,17),                             X00002710
                                                                        00002720
```

Figure A-2. Distribution Tape File COMBIMAN.INSTLJCL: Job Control Language to Initialize Files and Copy File 3 through File 17 from the Distribution Tape. (Continued)

# APPENDIX B

## LINKAGE EDITOR MAPS OF THE COMBIMAN PROGRAM SUIT

```
F64-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED SIZE=(360K,50K),CALL,INVALID,MAP
          VARIABLE OPTIONS USED -  SIZE=(368400,51200)
          SYSPRINT DEFAULT BLOCKING USED   1 - 1
```

MODULE MAP

CONTROL SECTION

| NAME | ORIGIN | LENGTH |
|---|---|---|
| CBMABC | 00 | C94 |
| CBMANT | C98 | 1E2 |
| CBMARM | E80 | 1A44 |
| CBMASM | 28C8 | 1416 |
| CBMBEA | 3CE0 | F6 |
| CBMBOT | 3DD8 | 2AE |
| CBMBOX | 4088 | 81E |
| CBMBVS | 48A8 | AF6 |
| CBMCCY | 53A0 | 67E |
| CBMCDP | 5920 | 244 |
| CBMCDS | 5B68 | 283C |
| CBMCD2 | 83A8 | 47C |
| CBMCLO | 8828 | 952 |
| CBMCMR | 9180 | E9C |
| CBMCNS | A020 | 2F6 |
| CBMCNV | A318 | 200 |
| CBMCOG | A518 | 246 |
| CBMCP1 | A760 | 8198 |
| CBMCP2 | 168F8 | F3A |
| CBMCP3 | 16838 | 7168 |
| CBMCP4 | 1D990 | 866 |
| CBMCRD | 1E4F8 | 2D8 |
| CBMCRP | 1E7D0 | 17E |
| CBMCRW | 1E960 | 1630 |
| CBMCSR | 1FF80 | 313C |
| CBMCS1 | 230C0 | 9EC |
| CBMCVS | 23A80 | 155A |
| CBMCVW | 25010 | 6BA |
| CBMDAT | 256D0 | 15C |
| CBMDCL | 25830 | 784 |
| CBMDEP | 25F88 | 158E |
| CBMDIR | 27548 | 376 |
| CBMDPL | 278C0 | 52C |
| CBMDR2 | 27DF0 | 376 |
| CBMDSP | 28168 | 43F2 |
| CBMDT3 | 2C560 | 224 |
| CBMDT4 | 2C788 | 494 |
| CBMENF | 2CC20 | FF2 |
| CBMENV | 2DC18 | 289A |
| RDIST | 30488 | 19A |
| DLINE | 30668 | 19A |
| CBMEN1 | 307F8 | A34 |
| CBMERS | 31230 | 1F4 |
| CBMGQA | 31428 | 47E |
| CBMGRT | 318A8 | 968 |
| CBMHAN | 32210 | 24A |
| CBMHAV | 32460 | 34FA |
| CBMHDV | 35960 | 4C6A |
| CBMHEL | 3A5D0 | 37A |
| CBMHIN | 3A950 | F68 |
| CBMHVS | 3B8B8 | 6448 |
| CBMIDP | 41D00 | F88 |
| CBMIND | 42C88 | 28FE |
| CBMINT | 45588 | 1D7A |
| CBMIN1 | 47308 | 2CA4 |
| CBMIOI | 49FB0 | 1480 |
| CBMJCT | 4B460 | 846 |
| CBMLEG | 4BCA8 | 1832 |
| CBMLPN | 4D4E0 | 20E |
| CBMMLT | 4D6F0 | 3FE |
| CBMPCH | 4DAF0 | 396 |

ENTRY

| NAME | LOCATION | NAME | LOCATION | NAME | LOCATION | NAME | LOCATION |
|---|---|---|---|---|---|---|---|

Figure B-1. Linkage Editor Map of CBM07.

| NAME | ORIGIN | LENGTH | NAME | LOCATION | NAME | LOCATION | NAME | LOCATION | NAME | LOCATION |
|---|---|---|---|---|---|---|---|---|---|---|
| CBMPEF | 4DE88 | 6E6 | | | | | | | | |
| CBMPFK | 4E570 | 260 | | | | | | | | |
| CBMPLN | 4E7D0 | 1B30 | | | | | | | | |
| CBMPNL | 50300 | A46 | | | | | | | | |
| CBMPRT | 50D48 | C02 | | | | | | | | |
| CBMPSP | 51950 | 63E | | | | | | | | |
| CBMPST | 51F90 | 3AE | | | | | | | | |
| CBMRAN | 52340 | 16B2 | | | | | | | | |
| CBMRCH | 539F8 | 1F5C | | | | | | | | |
| CBMRCK | 55958 | 896 | | | | | | | | |
| CBMREC | 561F0 | 1B9C | | | | | | | | |
| CBMXMN | 57D90 | 2F8 | | | | | | | | |
| CBMRCD | 58088 | 346 | | | | | | | | |
| CBMORD | 583D0 | 644E | | | | | | | | |
| CBMRHC | 5E820 | FCC4 | | | | | | | | |
| CBMRIN | 6E4E8 | F8A | | | | | | | | |
| CBMRMD | 6F478 | 1E0 | | | | | | | | |
| CBMRPY | 6F658 | 218 | | | | | | | | |
| CBMRP1 | 6F870 | 2B2 | | | | | | | | |
| CBMRSC | 6FB28 | 62C4 | | | | | | | | |
| CBMRST | 75DF0 | 3F72 | | | | | | | | |
| CBMRTC | 79D68 | 92E | | | | | | | | |
| CBMRTS | 7A698 | 7AE | | | | | | | | |
| CBMSAM | 7AE48 | 1F1E | | | | | | | | |
| CBMSND | 7CD68 | F6 | | | | | | | | |
| CBMSSW | 7CE60 | 9EC | | | | | | | | |
| CBMSTR | 7D850 | 2544 | | | | | | | | |
| CBMTBL | 7FD98 | 9A4 | | | | | | | | |
| CBMTK1 | 80740 | 174 | | | | | | | | |
| CBMTNG | 808B8 | E7C | | | | | | | | |
| CBMTRK | 81738 | 9A8 | | | | | | | | |
| CBMTRM | 820E0 | 384 | | | | | | | | |
| CBMTRN | 82468 | 2A2 | | | | | | | | |
| CBMTSK | 82710 | F6 | | | | | | | | |
| CBMVIS | 82808 | 22FE | | | | | | | | |
| CBMVS1 | 84B08 | 1898 | | | | | | | | |
| CBMVS2 | 863A0 | 18A | | | | | | | | |
| CBMVS3 | 86530 | 1D20 | | | | | | | | |
| CBMVS4 | 88250 | 410 | | | | | | | | |
| CBMVS5 | 88660 | 194 | | | | | | | | |
| CBMVS6 | 887F8 | 12C0 | | | | | | | | |
| CBMXCL | 89AB8 | 2EE | | | | | | | | |
| CBMXHR | 89DA8 | B42 | | | | | | | | |
| CBMYST | 8A8F0 | 428 | | | | | | | | |
| CBMZAP | 8AD18 | F6 | | | | | | | | |
| CBMZMM | 8AE10 | 456 | | | | | | | | |
| INTPLT | 8B268 | 162 | | | | | | | | |
| PLTNOW | 8B3D0 | 1AC | | | | | | | | |
| IHCGSP03 | 8B580 | 15C | | | | | | | | |
| | | | INDEV | 8B580 | TMDEV | 8B584 | INGDS | 8B588 | TMGDS | 8B58C |
| | | | CRATL | 8B590 | ENATL | 8B594 | ENATN | 8B598 | DSATN | 8B59C |
| | | | MPATL | 8B5A0 | MLPEO | 8B5A4 | SLPAT | 8B5A8 | MLITS | 8B5AC |
| | | | RQATN | 8B5B0 | EURATL | 8B5B4 | SETATN | 8B5B8 | SALRM | 8B5BC |
| | | | GSPRD | 8B5C0 | RCURS | 8B5C4 | ICURS | 8B5C8 | SDATM | 8B5CC |
| | | | SGRAM | 8B5D0 | SDATL | 8B5D4 | SGDSL | 8B5D8 | SSCIS | 8B5DC |
| | | | SCHAM | 8B5E0 | PLINE | 8B5E4 | PPNT | 8B5E8 | PSGMT | 8B5EC |
| | | | PTEXT | 8B5F0 | STPOS | 8B5F4 | MVPOS | 8B5F8 | BGSEQ | 8B5FC |
| | | | BGSUB | 8B600 | ENSEQ | 8B604 | ENSUB | 8B608 | LKSUB | 8B60C |
| | | | INCL | 8B610 | OMIT | 8B614 | EXEC | 8B618 | RESET | 8B61C |
| | | | IDPOS | 8B620 | FSMOD | 8B624 | STEOS | 8B628 | ORGDS | 8B62C |
| | | | LOCPN | 8B630 | BGTRK | 8B634 | RDTRK | 8B638 | ENTRK | 8B63C |
| | | | DFSTR | 8B640 | PLSTR | 8B644 | ORGEN | 8B648 | CNVRT | 8B64C |
| | | | ITRC | 8B650 | ITBP | 8B654 | RTBP | 8B658 | ITST | 8B65C |
| IHCGSP02 | 8B6E0 | EA | SPEC | 8B660 | | | | | | |
| IHCGSP01 | 8B7D0 | A2 | TMGSP | 8B6E0 | | | | | | |
| IHOSASCN* | 8B878 | 1F7 | INGSP | 8B7D0 | | | | | | |
| | | | ARCOS | 8B878 | ACOS | 8B878 | IH$ARCOS | 8B878 | ASIN | 8B88E |
| IHOSATN2* | 8BA70 | 1E8 | ARSIN | 8B88E | IH$ARSIN | 8B88E | | | | |
| IHOSSCN * | 8BC58 | 200 | ATAN2 | 8BA70 | IH$ATAN2 | 8BA70 | ATAN | 8BA84 | IH$ATAN | 8BA84 |
| | | | COS | 8BC58 | IH$$COS | 8BC58 | SIN | 8BC7A | IH$$SIN | 8BC7A |

Figure B-1. Linkage Editor Map of CBM07. (Continued)

| NAME | ORIGIN | LENGTH | NAME | LOCATION | NAME | LOCATION | NAME | LOCATION | NAME | LOCATION |
|---|---|---|---|---|---|---|---|---|---|---|
| IHOSEXP * | 8BE60 | 1B0 | EXP | 8BE60 | IH$$EXP | 8BE60 | | | | |
| IHOFRXPR* | 8C010 | 190 | FRXPR# | 8C010 | | | | | | |
| IHOECOMH* | 8C1B0 | EB0 | IBCOM# | 8C1DC | IB081971 | 8C1DC | FDIOCS# | 8C298 | INTSWTCH | 8CF98 |
| FIOAP# * | 8D060 | 6F4 | AP081971 | 8D404 | | | | | | |
| IHOCOMH2* | 8D758 | 9C6 | SEQDASD | 8DB12 | | | | | | |
| PLOT * | 8E120 | A2E | | | | | | | | |
| | | | FACTOR | 8E5C4 | NEWPEN | 8E686 | OFFSET | 8E6D4 | SETMSG | 8E75C |
| | | | WHERE | 8E7A4 | | | | | | |
| IHOSSQRT* | 8EB60 | 168 | SQRT | 8EB60 | IH$SQRT | 8EB60 | | | | |
| WAITO * | 8ECB8 | 8C | | | | | | | | |
| IHOFMAXR* | 8ED48 | E6 | MAX1 | 8ED48 | MIN1 | 8ED5E | AMAX1 | 8ED74 | AMIN1 | 8ED8A |
| AXIS * | 8EE30 | 6CA | | | | | | | | |
| IHCGSP04* | 8F500 | 2B8 | BCNV | 8F500 | | | | | | |
| IHOEDIOS* | 8F7B8 | EE2 | DIOCS# | 8F7B8 | | | | | | |
| IHOFRXPI* | 906A0 | 179 | FRXPI# | 906A0 | | | | | | |
| LINE * | 90820 | 4F2 | | | | | | | | |
| NUMBER * | 90D18 | 188 | | | | | | | | |
| PLOTS * | 90ED0 | 16C4 | | | | | | | | |
| RESERV * | 92598 | 2AE | RESRV | 90F60 | WINDOW | 90F28 | LYNE | 90F50 | COPIES | 90F78 |
| SCALE * | 92848 | 484 | LYNES | 925C8 | XGRIDX | 925F0 | | | | |
| SYMBOL * | 92CD0 | A6E | | | | | | | | |
| CURVE * | 93730 | B4A | | | | | | | | |
| GRID * | 94280 | 70E | HLINE | 94864 | VLINE | 94900 | | | | |
| IEVLNK * | 94990 | 4B6 | LINK# | 94D08 | | | | | | |
| IEVMAP * | 94E48 | 3A0 | MAPP$ | 95006 | | | | | | |
| IEVSRT * | 951E8 | 27C | SORT# | 9536E | | | | | | |
| IEVVMP * | 95468 | 928 | | | | | | | | |
| PARMIN * | 95D90 | 6E6 | | | | | | | | |
| PLOTID * | 96478 | 28C | | | | | | | | |
| VECTR1 * | 96738 | 194 | | | | | | | | |
| IHOFCVTH* | 968D0 | A43 | VT1END | 967C8 | | | | | | |
| | | | ADCON# | 968D0 | FCVAOUTP | 9697A | FCVLOUTP | 96A8A | FCVZOUTP | 96B66 |
| IHOEFNTH* | 97318 | 800 | FCVIOUTP | 96F40 | FCVEOUTP | 97032 | FCVCOUTP | 97232 | INT6SWCH | 97294 |
| IHOEFIOS* | 97B18 | 118C | ARITH# | 97318 | ADJSWTCH | 978AC | | | | |
| IHOFIOS2* | 98CA8 | 642 | FIOCS# | 97B18 | FIOCSBEP | 97B1E | | | | |
| IHOSLOG * | 992F0 | 1D4 | | | | | | | | |
| | | | ALOG10 | 992F0 | LOG10 | 992F0 | IH$ALOG0 | 992F0 | IH$ALOG | 99308 |
| IHOERRM * | 994C8 | 624 | LOG | 99308 | ALOG | 99308 | | | | |
| IHOUOPT * | 99AF0 | 338 | ERRMON | 994C8 | IHOERRE | 994E0 | | | | |
| OCODER * | 99E28 | 386 | | | | | | | | |
| IHOFIXPI* | 9A1B0 | 14F | | | | | | | | |
| | | | FIXPI# | 9A1B0 | | | | | | |

Figure B-1. Linkage Editor Map of CBM07. (Continued)

| NAME | | ORIGIN | LENGTH | NAME | LOCATION | NAME | LOCATION | NAME | LOCATION | NAME | LOCATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| IEVVRT | * | 9A300 | 3C0 | VORT* | 9A588 | | | | | | |
| IHOUATBL | * | 9A6C0 | 638 | | | | | | | | |
| IROM | * | 9ACF8 | 58 | | | | | | | | |
| JOBID | * | 9AD60 | 140 | | | | | | | | |
| MSGLOG | * | 9AE90 | 11EE | | | | | | | | |
| VECTOR | * | 9C080 | 38C | | | | | | | | |
| IHOFCONI | * | 9C410 | 2FD | FQCONI* | 9C410 | | | | | | |
| IHOFCONO | * | 9C710 | 4C2 | FQCONO* | 9C710 | | | | | | |
| IHOETRCH | * | 9C808 | 2AE | IHOTRCH | 9C808 | ERRTRA | 9CBE0 | | | | |
| INCEPT | * | 9CE88 | 84 | | | | | | | | |
| PLOTLOG | * | 9CF40 | 546 | SETLOG | 9D16C | ENDLOG | 9D1B2 | | | | |
| IHOFTEN | * | 9D488 | 198 | FTEN* | 9D488 | | | | | | |
| NCODER | * | 9D620 | 288 | | | | | | | | |
| CBMBDM | | 9D8A8 | 206C | | | | | | | | |
| CBMJC1 | | 9F918 | 258 | | | | | | | | |
| CBMREN | | 9FB70 | 1B4 | | | | | | | | |
| CBMRGR | | 9FD28 | 4D78 | | | | | | | | |
| CBMGRA | | A4AA0 | 8C | | | | | | | | |
| CBMRCA | | A4B30 | AD8 | | | | | | | | |
| CBMSAP | | A5608 | C | | | | | | | | |
| CBMVEW | | A5618 | C8 | | | | | | | | |
| CBMPDT | | A56E0 | 20 | | | | | | | | |
| CBMXYZ | | A5700 | 6668 | | | | | | | | |
| CBMBTD | | ABD68 | 1EB8 | | | | | | | | |
| CBMMCR | | ADC20 | 12C0 | | | | | | | | |
| CBMCYD | | AEEE0 | 19964 | | | | | | | | |
| CBMWDC | | C8848 | 20 | | | | | | | | |
| CBMCG | | C8868 | 15FA0 | | | | | | | | |
| CBMHOD | | DE808 | 92BC | | | | | | | | |
| CBMHHD | | E7AC8 | 11D7C | | | | | | | | |
| CBMCL2 | | F9848 | 23284 | | | | | | | | |
| CBMCLT | | 11CAD0 | 8 | | | | | | | | |
| CBMBXY | | 11CAD8 | 41A0 | | | | | | | | |
| CBMETN | | 120C78 | 40 | | | | | | | | |
| CBMPLT | | 120CB8 | 25C | | | | | | | | |
| CBMCSD | | 120F18 | 3390 | | | | | | | | |
| CBMDAV | | 1242A8 | 10 | | | | | | | | |
| CBMBDS | | 1242B8 | 2974 | | | | | | | | |
| CBMGEN | | 126C30 | 14 | | | | | | | | |
| CBMMRC | | 126C48 | 2D64 | | | | | | | | |
| CBMRMV | | 1299B0 | BB8 | | | | | | | | |
| CBMPTS | | 12A568 | 264 | | | | | | | | |
| XYZ | | 12A7D0 | 1AC | | | | | | | | |
| TSKTYP | | 12A980 | C | | | | | | | | |
| GPHCOM | | 12A990 | 198 | | | | | | | | |
| COEF | | 12AB28 | 24 | | | | | | | | |
| SORT | | 12AB50 | 3E84 | | | | | | | | |
| RCHCOM | | 12E9D8 | 14 | | | | | | | | |
| CBMRYS | | 12E9F0 | 14 | | | | | | | | |
| CBMVSB | | 12EA08 | 4E50 | | | | | | | | |
| CBMVSS | | 133858 | DFC | | | | | | | | |
| PPEP1 | | 134658 | 94 | | | | | | | | |
| VGRIDV | | 1346F0 | 3C | | | | | | | | |

ENTRY ADDRESS 7A698

TOTAL LENGTH 134730
****CBM07 NOW REPLACED IN DATA SET
AUTHORIZATION CODE IS 0.

Figure B-1. Linkage Editor Map of CBM07. (Continued)

```
IEW0000           INCLUDE OLDMOD(CBMAM)
IEW0000           ENTRY MAIN                                                                  00000290
IEW0000          NAME CBMAM(R)                                                                00000300
                                                                                              00000310
                                                  MODULE MAP
  CONTROL SECTION                        ENTRY

   NAME      ORIGIN  LENGTH               NAME      LOCATION    NAME      LOCATION    NAME      LOCATION    NAME      LOCATION
  MAIN           00    6394
  CBMADP       6398     25C
  CBMDAT       65F8     15C
  IHOEDIOS     6758     EE2

  IHOECOMH     7640     EB0              DIOCS#      6758

  FIOAP#       84F0     6F4              IBCOM#      766C      IB081971    766C      FDIOCS#     7728      INTSWTCH    8428

  IHOCOMH2     8BE8     9C5              AP081971    8964

  IHOFCVTH     95B0     A43              SEGDASD     8FA2

                                         ADCON#      95B0      FCVAOUTP    965A      FCVLOUTP    96EA      FCVZOUTP    9846
  IHOEFNTH     9FF8     800              FCVIOUTP    9C20      FCVEOUTP    9D12      FCVCOUTP    9D12      INT6SWCH    9F74

  IHOEFIOS     A7F8    118C              ARITH#      9FF8      ADJSWTCH    A58C

  IHOFIOS2     B988     642              FIOCS#      A7F8      FIOCSBEP    A7FE
  IHOERRM      BFD0     624

  IHOUATBL     C5F8     638              ERRMON      BFD0      IHOERRE     BFE8
  IHOUOPT      CC30     338
  IHOFCONI     CF68     2FD

  IHOFCONO     D268     4C2              FQCONI#     CF68

  IHOETRCH     D730     2AE              FQCONO#     D268

  IHOFTEN      D9E0     198              IHOTRCH     D730      ERRTRA      D738

  CBMADC       DB78      20              FTEN#       D9E0

 ENTRY ADDRESS        00

 TOTAL LENGTH       DB98
****CBMAM     DOES NOT EXIST BUT HAS BEEN ADDED TO DATA SET
AUTHORIZATION CODE IS           0.
```

Figure B-2. Linkage Editor Map of CBMAM.

```
IEW0000          INCLUDE OLDMOD(CBMCM)
IEW0000          ENTRY CBMCOM                                                00000320
IEW0000         NAME CBMCM(R)                                                00000330
                                                                             00000340
```

MODULE MAP

| CONTROL SECTION | | | ENTRY | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| NAME | ORIGIN | LENGTH | NAME | LOCATION | NAME | LOCATION | NAME | LOCATION | NAME | LOCATION |
| CBMCOM | 00 | E728 | | | | | | | | |
| CBMCDP | E728 | 24C | | | | | | | | |
| CBMDAT | E978 | 15C | | | | | | | | |
| CBMDT3 | EAD8 | 224 | | | | | | | | |
| CBMDT4 | ED00 | 494 | | | | | | | | |
| CBMTRN | F198 | 2A2 | | | | | | | | |
| IHOEDIOS | F440 | EE2 | DIOCS# | F440 | | | | | | |
| IHOECOMH | 10328 | EB0 | IBCOM# | 10354 | IB081971 | 10354 | FDIOCS# | 10410 | INTSWTCH | 11110 |
| FIOAP# | 111D8 | 6F4 | AP081971 | 1164C | | | | | | |
| IHOCOMH2 | 118D0 | 9C5 | SEGDASD | 11CBA | | | | | | |
| IHOSSQRT | 12298 | 168 | SQRT | 12298 | IHSSQRT | 12298 | | | | |
| IHOFCVTH | 12400 | A43 | ADCON# | 12400 | FCVAOUTP | 124AA | FCVLOUTP | 1253A | FCVZOUTP | 12696 |
| | | | FCVIOUTP | 12A70 | FCVEOUTP | 12B62 | FCVCOUTP | 12B62 | INT6SWCH | 12DC4 |
| IHOEFNTH | 12E48 | 800 | ARITH# | 12E48 | ADJSWTCH | 133DC | | | | |
| IHOEFIOS | 13648 | 118C | FIOCS# | 13648 | FIOCSBEP | 1364E | | | | |
| IHOFIOS2 | 147D8 | 642 | | | | | | | | |
| IHOERRM | 14E20 | 624 | ERRMON | 14E20 | IHOERRE | 14E38 | | | | |
| IHOUATBL | 15448 | 638 | | | | | | | | |
| IHOUOPT | 15A80 | 338 | | | | | | | | |
| IHOFCONI | 15DB8 | 2FD | FOCONI# | 15DB8 | | | | | | |
| IHOFCONO | 160B8 | 4C2 | FOCONO# | 160B8 | | | | | | |
| IHOETRCH | 16580 | 2AE | IHOTRCH | 16580 | ERRTRA | 16588 | | | | |
| IHOFTEN | 16830 | 198 | FTEN# | 16830 | | | | | | |
| CBMMDC | 169C8 | 20 | | | | | | | | |

```
ENTRY ADDRESS        00

 TOTAL LENGTH       169E8
****CBMCM     DOES NOT EXIST BUT HAS BEEN ADDED TO DATA SET
AUTHORIZATION CODE IS          0.
```

Figure B-3.  Linkage Editor Map of CBMCM.

```
IEW0000          INCLUDE OLDMOD(CBMCM2)
IEW0000          ENTRY MAIN                                                        00000350
IEW0000          NAME CBMCM2(R)                                                    00000360
                                                                                   00000370
                                             MODULE MAP
  CONTROL SECTION                    ENTRY

   NAME      ORIGIN  LENGTH             NAME      LOCATION    NAME      LOCATION    NAME      LOCATION    NAME      LOCATION
 MAIN            00    5A1A
 CBMCD2        5A20     3C0
 CBMCOG        5DE0     1E4
 CBMDR2        5FC8     2DE
 CBMTRN        62A8     23A
 CBMDAT        64E8     15C
 IHOEDIOS      6648     EE2           DIOCS#      6648

 IHOECOMH      7530     EB0           IBCOM#      755C     IB0B1971   755C      FDIOCS#     7618      INTSWTCH    8318

 FIOAP#        83E0     6F4           AP0B1971    8854

 IHOCOMH2      8AD8     9C5           SEGDASD     8E92

 IHOSSQRT      94A0     168           SQRT        94A0     IH#SQRT    94A0

 IHOFCVTH      9608     A43           ADCON#      9608     FCVAOUTP   9682      FCVLOUTP    9742      FCVZOUTP    989E
                                      FCVIOUTP    9C78     FCVEOUTP   9D6A      FCVCOUTP    9D6A      INT6SWCH    9FCC
 IHOEFNTH      A050     800           ARITH#      A050     ADJSWTCH   A5E4

 IHOEFIOS      A850    118C           FIOCS#      A850     FIOCSBEP   A856

 IHOFIOS2      B9E0     642
 IHOERRM       C028     624           ERRMON      C028     IHOERRE    C040

 IHOUATBL      C650     638
 IHOUOPT       CC88     338
 IHOFCONI      CFC0     2FD           FQCONI#     CFC0

 IHOFCOND      D2C0     4C2           FQCOND#     D2C0

 IHOETRCH      D788     2AE           IHOTRCH     D788     ERRTRA     D790

 IHOFTEN       DA38     198           FTEN#       DA38

 CBMCB         DBD0   15FA0
 CBMMDC       23B70      20
 CBMCRW       23B90      3C

ENTRY ADDRESS        00

TOTAL LENGTH       23BD0
****CBMCM2    NOW REPLACED IN DATA SET
AUTHORIZATION CODE IS           0.
```

Figure B-4. Linkage Editor Map of CBMCM2.

```
F64-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,MAP,SIZE=(360K,50K),CALL
          VARIABLE OPTIONS USED -  SIZE=(368400,51200)
          SYSPRINT DEFAULT BLOCKING USED   1 - 1
IEW0000         INCLUDE CBMLIB(CBMODM,CBMODP)                                 00000480
IEW0000         INCLUDE CBMLIB2(CBMDAT)                                       00000600
IEW0000         NAME     CBMODM(R)                                            00000640


                                            MODULE MAP

 CONTROL SECTION                      ENTRY

  NAME      ORIGIN  LENGTH             NAME    LOCATION     NAME    LOCATION     NAME    LOCATION     NAME    LOCATION
 MAIN           00    2920
 CBMODP       2920     244
 CBMDAT       2B68     15C
 IHOEDIOS*    2CC8     EE2
                                      DIOCS#     2CC8
 IHOECOMH*    3BB0     EB0
                                      IBCOM#     3BDC      IB001971    3BDC      FDIOCS#     3C98      INTSWTCH    4998
 FIOAP#  *    4A60     6F4
                                      AP001971   4ED4
 IHOCOMH2*    5158     9C5
                                      SEQDASD    5612
 IHOFCVTH*    5B20     A43
                                      ADCON#     5B20      FCVAOUTP    5BCA      FCVLOUTP    5C5A      FCVZOUTP    5D86
                                      FCVIOUTP   6190      FCVEOUTP    6282      FCVCOUTP    6282      INT6SWCH    64E4
 IHOEFNTH*    6568     800
                                      ARITH#     6568      ADJSWTCH    6AFC
 IHOEFIOS*    6D68    118C
                                      FIOCS#     6D68      FIOCSBEP    6D6E
 IHOFIOS2*    7EF8     642
 IHOERRM *    8540     624
                                      ERRMON     8540      IHOERRE     8558
 IHOUATBL*    8B68     638
 IHOUOPT *    91A0     338
 IHOFCONI*    94D8     2FD
                                      FQCONI#    94D8
 IHOFCONO*    97D8     4C2
                                      FQCONO#    97D8
 IHOETRCH*    9CA0     2AE
                                      IHOTRCH    9CA0      ERRTRA      9CA8
 IHOFTEN *    9F50     198
                                      FTEN#      9F50
 CBMODC       A0E8      20

ENTRY ADDRESS       00

TOTAL LENGTH       A108
****CBMODM    NOW REPLACED IN DATA SET
AUTHORIZATION CODE IS          0.
```

Figure B-5. Linkage Editor Map of CBMODM.

# APPENDIX C

## SAMPLE JOB CONTROL LANGUAGE AND DATA FOR THE COMBIMAN PROGRAM UNIT

```
//CBM$0 JOB UDRI,COMBIMAN,CLASS=E,MSGCLASS=A,REGION=2000K                 00001000
//*********************************************************************** *00001005
//*          COMBIMAN PRODUCTION JOB CONTROL FILE                          *00001010
//*          -----------------------------------                           *00001020
//*     THIS JCL IS USED TO RUN THE COMBIMAN INTERACTIVE                   *00001030
//*     ANALYSIS PROGRAM. USE THIS JCL ONLY IF YOU HAVE                    *00001040
//*     AN ON-LINE PLOTTER. (NOTE: THE SYSVECTR DD CARD                    *00001050
//*     MUST POINT TO THE ON-LINE PLOTTER; THE FT10F001                    *00001060
//*     DD CARD MUST POINT TO THE GRAPHICS SCOPE.)                         *00001070
//*+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++*00001080
//*              UNIVERSITY OF DAYTON RESEARCH INSTITUTE                   *00001090
//*                     COMBIMAN, VERSION 7    (10/86)                     *00001091
//***********************************************************************  *00001191
//JOBLIB    DD   DSN=COMBIMAN.LOADLIB,DISP=SHR                             00001200
//CBMEXEC EXEC PGM=CBM07,REGION=1000K,PARM=(PRINT)                         00001400
//SYSLOUT   DD   SYSOUT=*                                                  00001500
//SYSPRINT DD   SYSOUT=*                                                   00001600
//FT01F001 DD   DSN=COMBIMAN.INITNEW,DISP=SHR                              00001700
//FT02F001 DD   DSN=COMBIMAN.ANTHDATA,DISP=SHR                             00001800
//FT03F001 DD   DSN=COMBIMAN.CRSTDATA,DISP=SHR                             00001900
//FT04F001 DD   DSN=COMBIMAN.CRSTDAT1,DISP=SHR                             00002000
//FT05F001 DD   DSN=COMBIMAN.SMPLANTH,DISP=SHR                             00002100
//FT06F001 DD   SYSOUT=*                                                   00002200
//FT07F001 DD   DUMMY                                                      00002300
//FT08F001 DD   SYSOUT=*                                                   00002400
//FT09F001 DD   DSN=COMBIMAN.OVERLAY.DATA,DISP=SHR                         00002500
//*-------------------------------------------------------------------     00002510
//*       THE FT10F001 DD CARD POINTS TO THE INTERACTIVE                   00002520
//*       GRAPHICS SCOPE.                                                  00002530
//*-------------------------------------------------------------------     00002540
//FT10F001 DD   UNIT=1E0                                                   00002600
//FT11F001 DD   DSN=COMBIMAN.PLOTDATA,DISP=SHR                             00002700
//FT14F001 DD   DSN=COMBIMAN.RCHDATA,DISP=SHR                              00003000
//FT15F001 DD   DSN=COMBIMAN.HELMET.DATA,DISP=SHR,LABEL=(,,,IN)            00003100
//FT16F001 DD   DSN=COMBIMAN.BOOT.DATA,DISP=SHR,LABEL=(,,,IN)              00003300
//FT17F001 DD   DSN=COMBIMAN.HEAD.DATA,DISP=SHR,LABEL=(,,,IN)              00003600
//FT18F001 DD   DSN=COMBIMAN.HAND.DATA,DISP=SHR,LABEL=(,,,IN)              00003600
//FT25F001 DD   DSN=COMBIMAN.STRENGTH.DATA,DISP=SHR                        00003700
//*                                                                        00003710
//*---VERSATEC PLOTTING FILE DEFINITIONS.                                  00003720
//*                                                                        00003730
//PLOTPARM DD   *                                                          00003800
 &PLOT  MODEL=8222,XMAX=100.0,LYNES=200,MODE=0,                            00003810
  ID=1,LBLK=24200,IOPT=2,IOMASK=10000,XMIN=0.0,YMIN=0.0 &END               00003820
//PLOTLOG   DD  DUMMY                                                      00003900
//VECTR1    DD  DSN=&&VECTR1,UNIT=DISK,SPACE=(TRK,(1,1)),DISP=(,PASS)      00004000
//VECTR2    DD  DSN=&&VECTR2,UNIT=DISK,SPACE=(CYL,(1,1)),DISP=(,PASS)      00004100
//*-------------------------------------------------------------------     00004210
//*   THE SYSVECTR DD CARD MUST POINT TO THE PLOTTER                       00004220
//*-------------------------------------------------------------------     00004230
//SYSVECTR DD   UNIT=0EE,DCB=(LRECL=133,RECFM=FA,BLKSIZE=133),             00004300
//            UCS=T11,FCB=STD1                                             00004400
//*SYSABEND DD   SYSOUT=*                                                  00004500
//*SYSBFDMP DD SYSOUT=*                                                    00004600
/*                                                                         00004700
//                                                                         00004800
```

Figure C-1. Distribution Tape File COMBIMAN.PROCNJCL (CBM07): Sample JCL to Run CBM07.

```
//CBMS0 JOB UDRI,COMBIMAN,CLASS=E,MSGCLASS=A,REGION=2000K
//*********************************************************************
//*        COMBIMAN PRODUCTION JOB CONTROL FILE                       *
//*        ----------------------------------                         *
//*    THIS JCL IS USED TO RUN THE COMBIMAN INTERACTIVE               *
//*    ANALYSIS PROGRAM. USE THIS IF YOU DO NOT HAVE                  *
//*    AN ON-LINE PLOTTER. (NOTE: THE SYSVECTR DD CARD                *
//*    HERE HAS BEEN DUMMIED OUT,ALTHOUGH IT IS NOT NEEDED.           *
//*    ALL OF THE ON-LINE PLOT CAPABILITIES HAVE BEEN REMOVED         *
//*    FROM THIS VERSION OF COMBIMAN.                                 *
//*++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++*
//*            UNIVERSITY OF DAYTON RESEARCH INSTITUTE                *
//*                   COMBIMAN, VERSION 7   (10/85)                   *
//*********************************************************************
//JOBLIB   DD  DSN=COMBIMAN.LOADLIB,DISP=SHR
//CBMEXEC EXEC PGM=CBM07NOPL,REGION=1000K,PARM=(PRINT)
//SYSLOUT  DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*
//FT01F001 DD  DSN=COMBIMAN.INITNEW,DISP=SHR
//FT02F001 DD  DSN=COMBIMAN.ANTHDATA,DISP=SHR
//FT03F001 DD  DSN=COMBIMAN.CRSTDATA,DISP=SHR
//FT04F001 DD  DSN=COMBIMAN.CRSTDAT1,DISP=SHR
//FT05F001 DD  DSN=COMBIMAN.SMPLANTH,DISP=SHR
//FT06F001 DD  SYSOUT=*
//FT07F001 DD  DUMMY
//FT08F001 DD  SYSOUT=*
//FT09F001 DD  DSN=COMBIMAN.OVERLAY.DATA,DISP=SHR
//*-------------------------------------------------------------------
//*      THE FT10F001 DD CARD POINTS TO THE INTERACTIVE
//*      GRAPHICS SCOPE.
//*-------------------------------------------------------------------
//FT10F001 DD  UNIT=1E0
//FT11F001 DD  DSN=COMBIMAN.PLOTDATA,DISP=SHR
//FT14F001 DD  DSN=COMBIMAN.RCHDATA,DISP=SHR
//FT15F001 DD  DSN=COMBIMAN.HELMET.DATA,DISP=SHR,LABEL=(,,,IN)
//FT16F001 DD  DSN=COMBIMAN.BOOT.DATA,DISP=SHR,LABEL=(,,,IN)
//FT17F001 DD  DSN=COMBIMAN.HEAD.DATA,DISP=SHR,LABEL=(,,,IN)
//FT18F001 DD  DSN=COMBIMAN.HAND.DATA,DISP=SHR,LABEL=(,,,IN)
//FT25F001 DD  DSN=COMBIMAN.STRENGTH.DATA,DISP=SHR
//*
//*---VERSATEC PLOTTING FILE DEFINITIONS.
//*
//PLOTPARM DD  *
 &PLOT  MODEL=8222,XMAX=100.0,LYNES=200,MODE=0,
  ID=1,LBLK=24200,IOPT=2,IOMASK=10000,XMIN=0.0,YMIN=0.0 &END
//PLOTLOG   DD  DUMMY
//VECTR1    DD  DSN=&&VECTR1,UNIT=DISK,SPACE=(TRK,(1,1)),DISP=(,PASS)
//VECTR2    DD  DSN=&&VECTR2,UNIT=DISK,SPACE=(CYL,(1,1)),DISP=(,PASS)
//*-------------------------------------------------------------------
//*   THE SYSVECTR DD CARD MUST POINT TO THE PLOTTER
//*-------------------------------------------------------------------
//SYSVECTR DD  DUMMY,DCB=(LRECL=133,RECFM=FA,BLKSIZE=133),
//         UCS=T11,FCB=STD1
//*SYSABEND DD  SYSOUT=*
//*SYSBFDMP DD SYSOUT=*
/*
//
```

Figure C-2. Distribution Tape File COMBIMAN.PROCNJCL (CBM7NOPL): Sample JCL to Run CBM7NOPL.

```
//COMBIMAN JOB   CLASS=A,MSGCLASS=A,
//       TIME=(100,0),REGION=1024K
//*
//* ----------------------------------------------
//* -  COMBIMAN ANTHROPOMETRY DATA BASE          -
//* -  MAINTENANCE PROGRAM JCL FILE.             -
//* ----------------------------------------------
//*
//CBMAM    EXEC PGM=CBMAM
//STEPLIB   DD DSN=COMBIMAN.LOADLIB,DISP=SHR
//*
//FT02F001 DD DSN=COMBIMAN.ANTHDATA,
//             UNIT=DISK,
//             DISP=(NEW,CATLG),
//             SPACE=(248,2000),
//             DCB=(RECFM=F,LRECL=248,BLKSIZE=248)
//*
//FT05F001 DD DSN=COMBIMAN.DBDATA(CBMAM),DISP=SHR,LABEL=(,,,IN)
//*
//FT06F001 DD SYSOUT=A
//FT07F001 DD DUMMY
//*
```

Figure C-3. Distribution Tape File COMBIMAN.PRODNJCL (CBMAM): Sample JCL to Run CBMAM.

```
*INT                                                                            00000010
*ADD R67 USAF     0   18   28   12                                              00000020
 1 WEIGHT              LB    1        1                                         00000030
 2 SITTING HEIGHT      IN        1    1                                         00000040
 3 EYE HGT/SITTING     IN        1                                              00000050
 4 ACROMION HGT/SIT    IN             1                                         00000060
 5 ARM LENGTH          IN        1                                              00000070
 6 THUMB-TIP REACH     IN        1                                              00000080
 7 SHOULDR-ELB LGTH    IN             1                                         00000090
 8 KNEE HGT/SITTING    IN        1    1                                         00000100
 9 BUTTOCK-KNE LGTH    IN        1    1                                         00000110
10 BIACROMIAL BRDTH    IN             1                                         00000120
11 BIDELTIOD BRDTH     IN    1                                                  00000130
12 HIP BREADTH         IN             1                                         00000140
13 HIP BREADTH/SITT    IN    1                                                  00000150
14 CHEST DEPTH         IN    1        1                                         00000160
15 FOOT LENGTH         IN             1                                         00000170
16 HAND LENGTH         IN             1                                         00000180
17 ELBOW-WRIST LGTH    IN             1                                         00000190
18 LEG LENGTH          IN        1                                              00000200
  1  2        0.02669   32.05275   1.11161   7.84538-114.20831   19.05910       00000210
  1  2  1  1.0        0.0          0.0                                          00000220
  1  2  2  0.0        1.0000000    0.0                                          00000230
  1  2  4              .731       -2.779522                                     00000240
  1  2  7              .247        5.090541                                     00000250
  1  2  8              .404        7.133844                                     00000260
  1  2  9              .333       11.566906                                     00000270
  1  2 10  0.0131732 0.1105000     9.69417                                      00000280
  1  2 12  0.0279173 0.0043000     8.87957                                      00000290
  1  2 14  0.0313031-0.1665000    10.32958                                      00000300
  1  2 15  0.0069724 0.1248000     4.85468                                      00000310
  1  2 16              .117        3.232277                                     00000320
  1  2 17              .193        4.728337                                     00000330
  1  3        0.02287   27.89858   1.08116   7.45657 -64.02781   19.52158       00000340
  1  3  1  1.0        0.0          0.0                                          00000350
  1  3  2             0.979        5.48424                                      00000360
  1  3  4             0.737        0.55118                                      00000370
  1  3  7              .260        5.86613                                      00000380
  1  3  8              .403        9.114155                                     00000390
  1  3  9              .349       12.661392                                     00000400
  1  3 10  0.0141614 0.0857000    10.84526                                      00000410
  1  3 12  0.0278189 0.0093000     8.75802                                      00000420
  1  3 14  0.0304921-0.1587000     9.41976                                      00000430
  1  3 15  0.0075236 0.1215000     5.46532                                      00000440
  1  3 16              .113        3.921252                                     00000450
  1  3 17              .173        6.295263                                     00000460
  1  5        0.02833   26.15526   1.20042   7.19682 -50.02730   19.13435       00000470
  1  5  1  1.0        0.0          0.0                                          00000480
  1  5  2              .44707     22.78517                                      00000490
  1  5  4              .35904     12.87857                                      00000500
  1  5  7              .43726       .56455                                      00000510
  1  5  8              .60757      3.07370                                      00000520
  1  5  9              .57349      5.95935                                      00000530
  1  5 10  0.01350    0.09244     10.81827                                      00000540
  1  5 12  0.02794    0.00304      8.93795                                      00000550
  1  5 14  0.02896   -0.07272      6.88447                                      00000560
  1  5 15             0.23926      3.20737                                      00000570
  1  5 16              .18333      1.82567                                      00000580
  1  5 17              .34779      1.00030                                      00000590
  1  6        0.03029   26.35823   1.42612   5.66767  -5.58512   19.50835       00000600
```

Figure C-4. Distribution Tape File COMBIMAN.DBDATA (CBMAM): Sample Data to Create R67 USAF Regression Member and 67 USAF Survey Member of the COMBIMAN Anthropometric Data Base.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 6 | 1 | 1.0 | 0.0 | 0.0 | | | | |
| 1 | 6 | 2 | | 330 | 26.251916 | | | | 00000610 |
| 1 | 6 | 4 | | .250 | 16.133826 | | | | 00000620 |
| 1 | 6 | 7 | | .291 | 4.952744 | | | | 00000630 |
| 1 | 6 | 8 | | .439 | 8.074787 | | | | 00000640 |
| 1 | 6 | 9 | | .410 | 10.818876 | | | | 00000650 |
| 1 | 6 | 10 | 0.0136811 | 0.0805000 | 11.11438 | | | | 00000660 |
| 1 | 6 | 12 | 0.0281693 | -0.0046000 | 9.13904 | | | | 00000670 |
| 1 | 6 | 14 | 0.0279646 | -0.0362000 | 5.94550 | | | | 00000680 |
| 1 | 6 | 15 | 0.0063701 | 0.1298000 | 5.43332 | | | | 00000690 |
| 1 | 6 | 16 | | .119 | 3.759835 | | | | 00000700 |
| 1 | 6 | 17 | | .243 | 4.125976 | | | | 00000710 |
| 1 | 8 | | 0.02470 | 17.66583 | 0.82738 | | | | 00000720 |
| 1 | 8 | 1 | 1.0 | 0.0 | 0.0 | 11.76173 | -84.61144 | 18.05449 | 00000730 |
| 1 | 8 | 2 | | .656 | 22.28342 | | | | 00000740 |
| 1 | 8 | 4 | | .510 | 12.838557 | | | | 00000750 |
| 1 | 8 | 7 | | .516 | 2.822829 | | | | 00000760 |
| 1 | 8 | 8 | 0.0 | 1.0000000 | 0.0 | | | | 00000770 |
| 1 | 8 | 9 | | .851 | 5.098415 | | | | 00000780 |
| 1 | 8 | 10 | 0.0125630 | 0.1442000 | 10.68774 | | | | 00000790 |
| 1 | 8 | 12 | 0.0282283 | -0.0081000 | 9.16118 | | | | 00000800 |
| 1 | 8 | 14 | 0.0301890 | -0.1347000 | 7.37230 | | | | 00000810 |
| 1 | 8 | 15 | 0.0030315 | 0.2947000 | 3.64651 | | | | 00000820 |
| 1 | 8 | 16 | | .215 | 2.803144 | | | | 00000830 |
| 1 | 8 | 17 | | .443 | 2.082673 | | | | 00000840 |
| 1 | 9 | | 0.03158 | 18.29894 | 0.82109 | | | | 00000850 |
| 1 | 9 | 1 | 1.0 | 0.0 | 0.0 | 12.81257 | -131.08463 | 16.53998 | 00000860 |
| 1 | 9 | 2 | | .460 | 25.744043 | | | | 00000870 |
| 1 | 9 | 4 | | .358 | 15.523591 | | | | 00000880 |
| 1 | 9 | 7 | | .442 | 3.641725 | | | | 00000890 |
| 1 | 9 | 8 | | .725 | 4.712589 | | | | 00000900 |
| 1 | 9 | 9 | 0.0 | 1.0000000 | 0.0 | | | | 00000910 |
| 1 | 9 | 10 | 0.0158071 | 0.0097000 | 13.06010 | | | | 00000920 |
| 1 | 9 | 12 | 0.0267283 | 0.0412000 | 8.26378 | | | | 00000930 |
| 1 | 9 | 14 | 0.0293819 | -0.0795000 | 6.44568 | | | | 00000940 |
| 1 | 9 | 15 | 0.0033780 | 0.2192000 | 4.84350 | | | | 00000950 |
| 1 | 9 | 16 | | .165 | 3.598418 | | | | 00000960 |
| 1 | 9 | 17 | | .327 | 4.031488 | | | | 00000970 |
| 1 | 18 | | 0.05622 | 35.96162 | 1.51181 | | | | 00000980 |
| 1 | 18 | 1 | 1.0 | 0.0 | 0.0 | 6.91445 | -142.53891 | 16.76634 | 00000990 |
| 1 | 18 | 2 | | .30976 | 22.51437 | | | | 00001000 |
| 1 | 18 | 4 | | .24063 | 13.03307 | | | | 00001010 |
| 1 | 18 | 7 | | .26725 | 1.93244 | | | | 00001020 |
| 1 | 18 | 8 | | .47770 | 0.11136 | | | | 00001030 |
| 1 | 18 | 9 | | .52243 | -0.10713 | | | | 00001040 |
| 1 | 18 | 10 | 0.01351 | 0.04629 | 11.57140 | | | | 00001050 |
| 1 | 18 | 12 | 0.00000 | 0.19904 | 4.78254 | | | | 00001060 |
| 1 | 18 | 14 | 0.0279646 | -0.0362000 | 5.94550 | | | | 00001070 |
| 1 | 18 | 15 | | .16506 | 3.09540 | | | | 00001080 |
| 1 | 18 | 16 | | .10537 | 2.70440 | | | | 00001090 |
| 1 | 18 | 17 | | .21390 | 2.027133 | | | | 00001100 |
| 11 | 2 | | 0.34567 | 30.12037 | 1.20048 | | | | 00001110 |
| 11 | 2 | 1 | 16.9568 | 0.0 | -148.083 | 0.22538 | 10.72527 | 0.96934 | 00001120 |
| 11 | 2 | 2 | 0.0 | 1.0000000 | 0.0 | | | | 00001130 |
| 11 | 2 | 4 | | .731 | -2.779522 | | | | 00001140 |
| 11 | 2 | 7 | | .247 | 5.090541 | | | | 00001150 |
| 11 | 2 | 8 | | .404 | 7.133844 | | | | 00001160 |
| 11 | 2 | 9 | | .333 | 11.566906 | | | | 00001170 |
| 11 | 2 | 10 | 0.4600000 | 0.1104000 | 3.24965 | | | | 00001180 |
| 11 | 2 | 12 | 0.4129000 | 0.1303000 | 1.26161 | | | | 00001190 |
| | | | | | | | | | 00001200 |

Figure C-4. Distribution Tape File COMBIMAN.DBDATA (CBMAM): Sample Data to Create R67 USAF Regression Member and 67 USAF Survey Member of the COMBIMAN Anthropometric Data Base. (Continued)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 11 | 2 | 14 | 0.4789000 | -0.0288000 | 1.61592 | | | | 00001210 |
| 11 | 2 | 15 | 0.0873000 | 0.1599000 | 3.12040 | | | | 00001220 |
| 11 | 2 | 16 | | .117 | 3.232277 | | | | 00001230 |
| 11 | 2 | 17 | | .193 | 4.728337 | | | | 00001240 |
| 11 | 3 | | 0.30610 | 26.05530 | 1.14619 | 0.22134 | 11.93966 | 0.97466 | 00001250 |
| 11 | 3 | 1 | 16.9568 | 0.0 | -148.083 | | | | 00001260 |
| 11 | 3 | 2 | | 0.979 | 5.484241 | | | | 00001270 |
| 11 | 3 | 4 | | 0.737 | 0.55118 | | | | 00001280 |
| 11 | 3 | 7 | | .260 | 5.86613 | | | | 00001290 |
| 11 | 3 | 8 | | .403 | 9.114155 | | | | 00001300 |
| 11 | 3 | 9 | | .349 | 12.661392 | | | | 00001310 |
| 11 | 3 | 10 | 0.4715000 | 0.0869000 | 4.31225 | | | | 00001320 |
| 11 | 3 | 12 | 0.4201000 | 0.1234000 | 1.97291 | | | | 00001330 |
| 11 | 3 | 14 | 0.4806000 | -0.0381000 | 1.74185 | | | | 00001340 |
| 11 | 3 | 15 | 0.0945000 | 0.1566000 | 3.85737 | | | | 00001350 |
| 11 | 3 | 16 | | .113 | 3.921252 | | | | 00001360 |
| 11 | 3 | 17 | | .173 | 6.295263 | | | | 00001370 |
| 11 | 5 | | 0.39328 | 23.60365 | 1.28541 | 0.22157 | 12.10669 | 0.96481 | 00001380 |
| 11 | 5 | 1 | 16.9568 | 0.0 | -148.083 | | | | 00001390 |
| 11 | 5 | 2 | | .44707 | 22.78517 | | | | 00001400 |
| 11 | 5 | 4 | | .35904 | 12.87857 | | | | 00001410 |
| 11 | 5 | 7 | | .43726 | .56455 | | | | 00001420 |
| 11 | 5 | 8 | | .60757 | 3.07370 | | | | 00001430 |
| 11 | 5 | 9 | | .57349 | 5.95935 | | | | 00001440 |
| 11 | 5 | 10 | 0.46445 | 0.08667 | 4.52002 | | | | 00001450 |
| 11 | 5 | 12 | 0.41413 | 0.11238 | 2.52643 | | | | 00001460 |
| 11 | 5 | 14 | 0.45614 | 0.03465 | -0.08685 | | | | 00001470 |
| 11 | 5 | 15 | | 0.23926 | 3.20737 | | | | 00001480 |
| 11 | 5 | 16 | | .18333 | 1.82567 | | | | 00001490 |
| 11 | 5 | 17 | | .34779 | 1.00030 | | | | 00001500 |
| 11 | 6 | | 0.43448 | 23.36423 | 1.50431 | 0.18032 | 13.29244 | 0.96911 | 00001510 |
| 11 | 6 | 1 | 16.9568 | 0.0 | -148.083 | | | | 00001520 |
| 11 | 6 | 2 | | .330 | 26.25191 | | | | 00001530 |
| 11 | 6 | 4 | | .250 | 16.13382 | | | | 00001540 |
| 11 | 6 | 7 | | .291 | 4.952746 | | | | 00001550 |
| 11 | 6 | 8 | | .439 | 8.074787 | | | | 00001560 |
| 11 | 6 | 9 | | .410 | 10.81887 | | | | 00001570 |
| 11 | 6 | 10 | 0.4659000 | 0.0744000 | 4.83476 | | | | 00001580 |
| 11 | 6 | 12 | 0.4237000 | 0.0790000 | 3.34054 | | | | 00001590 |
| 11 | 6 | 14 | 0.4512000 | 0.0413000 | -0.21794 | | | | 00001600 |
| 11 | 6 | 15 | 0.0767000 | 0.1521000 | 4.37728 | | | | 00001610 |
| 11 | 6 | 16 | | .119 | 3.759835 | | | | 00001620 |
| 11 | 6 | 17 | | .243 | 4.125976 | | | | 00001630 |
| 11 | 8 | | 0.33166 | 15.65472 | 0.92347 | 0.35026 | 11.30381 | 0.94902 | 00001640 |
| 11 | 8 | 1 | 16.9568 | 0.0 | -148.083 | | | | 00001650 |
| 11 | 8 | 2 | | .656 | 22.28342 | | | | 00001660 |
| 11 | 8 | 4 | | .510 | 12.83855 | | | | 00001670 |
| 11 | 8 | 7 | | .516 | 2.822829 | | | | 00001680 |
| 11 | 8 | 8 | 0.0 | 1.0 | 0.0 | | | | 00001690 |
| 11 | 8 | 9 | | .851 | 5.098415 | | | | 00001700 |
| 11 | 8 | 10 | 0.4540000 | 0.1333000 | 4.48622 | | | | 00001710 |
| 11 | 8 | 12 | 0.3965000 | 0.1854000 | 2.28117 | | | | 00001720 |
| 11 | 8 | 14 | 0.4478000 | 0.0640000 | -0.25567 | | | | 00001730 |
| 11 | 8 | 15 | 0.0376000 | 0.3172000 | 2.96457 | | | | 00001740 |
| 11 | 8 | 16 | | .215 | 2.803144 | | | | 00001750 |
| 11 | 8 | 17 | | .443 | 2.082673 | | | | 00001760 |
| 11 | 9 | | 0.46362 | 14.97491 | 0.95564 | 0.41724 | 9.07114 | 0.90658 | 00001770 |
| 11 | 9 | 1 | 16.9568 | 0.0 | -148.083 | | | | 00001780 |
| 11 | 9 | 2 | | .460 | 25.74404 | | | | 00001790 |
| 11 | 9 | 4 | | .358 | 15.52359 | | | | 00001800 |

Figure C-4. Distribution Tape File COMBIMAN.DBDATA (CBMAM): Sample Data to Create R67 USAF Regression Member and 67 USAF Survey Member of the COMBIMAN Anthropometric Data Base. (Continued)

```
11  9  7                      .442        3.641725
11  9  8                      .725        4.712589                                     00001810
11  9  9  0.0                1.0000000    0.0                                          00001820
11  9 10  0.4949000 0.0068000             6.47457                                      00001830
11  9 12  0.3472000 0.2399000             1.58527                                      00001840
11  9 14  0.4105000 0.1268000            -1.15616                                      00001850
11  9 15  0.0263000 0.2516000             4.15868                                      00001860
11  9 16                      .165        3.598418                                     00001870
11  9 17                      .327        4.031488                                     00001880
11 18           0.79451     30.63203      1.75935   0.21668   9.08433   0.91879       00001890
11 18  1 16.9568              0.0      -148.083                                        00001900
11 18  2                      .30976     22.51437                                      00001910
11 18  4                      .24063     13.03307                                      00001920
11 18  7                      .26725      1.93244                                      00001930
11 18  8                      .47770      0.11136                                      00001940
11 18  9                      .52243     -0.10713                                      00001950
11 18 10  0.46811             0.03829     5.39269                                      00001960
11 18 12  0.36260             0.12047     1.48855                                      00001970
11 18 14  0.42663             0.05429    -0.93197                                      00001980
11 18 15                      0.16506     3.09540                                      00001990
11 18 16                      .10537      2.70440                                      00002000
11 18 17                      .21390      2.027133                                     00002010
13  2           0.46318     29.79372      1.17767   0.24312   5.96088   0.85322       00002020
13  2  1 20.2776              0.0      -127.757                                        00002030
13  2  2  0.0                1.0000000    0.0                                          00002040
13  2  4                      .731       -2.779522                                     00002050
13  2  7                      .247        5.090541                                     00002060
13  2  8                      .404        7.133844                                     00002070
13  2  9                      .333       11.566906                                     00002080
13  2 10  0.1935000 0.1669000             7.03065                                      00002090
13  2 12  0.7167000 0.0498000             1.39459                                      00002100
13  2 14  0.5539000-0.0551000             3.43517                                      00002110
13  2 15  0.1106000 0.1527000             3.39454                                      00002120
13  2 16                      .117        3.232277                                     00002130
13  2 17                      .193        4.728337                                     00002140
13  3           0.40811     25.79650      1.12810   0.23757   7.30887   0.86072       00002150
13  3  1 20.2776              0.0      -127.757                                        00002160
13  3  2                      0.979       5.484241                                     00002170
13  3  4                      0.737       0.55118                                      00002180
13  3  7                      .260        5.86613                                      00002190
13  3  8                      .403        9.114155                                     00002200
13  3  9                      .349       12.661392                                     00002210
13  3 10  0.2134000 0.1408000             8.37065                                      00002220
13  3 12  0.7207000 0.0468000             1.67072                                      00002230
13  3 14  0.5537000-0.0621000             3.39681                                      00002240
13  3 15  0.1206000 0.1491000             4.09600                                      00002250
13  3 16                      .113        3.921252                                     00002260
13  3 17                      .173        6.295263                                     00002270
13  5           0.49107     23.76631      1.26965   0.22274   7.95688   0.85508       00002280
13  5  1 20.2776              0.0      -127.757                                        00002290
13  5  2                      .44707     22.78517                                      00002300
13  5  4                      .35904     12.87857                                      00002310
13  5  7                      .43726      0.56455                                      00002320
13  5  8                      0.60757     3.07370                                      00002330
13  5  9                      0.57349     5.95935                                      00002340
13  5 10  0.19922             0.14520     8.55788                                      00002350
13  5 12  0.71817             0.04417     1.82575                                      00002360
13  5 14  0.51955             0.01999     1.30153                                      00002370
13  5 15                      0.23926     3.20737                                      00002380
13  5 16                      .18333      1.82567                                      00002390
                                                                                       00002400
```

Figure C-4. Distribution Tape File COMBIMAN.DBDATA (CBMAM): Sample Data to Create R67 USAF Regression Member and 67 USAF Survey Member of the COMBIMAN Anthropometric Data Base. (Continued)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 13 | 5 | 17 | | .34779 | 1.00030 | | | | 00002410 |
| 13 | 6 | | 0.51279 | 23.98611 | 1.49653 | 0.17133 | 9.46316 | 0.86504 | 00002420 |
| 13 | 6 | 1 | 20.2776 | 0.0 | -127.757 | | | | 00002430 |
| 13 | 6 | 2 | | .330 | 26.25191 | | | | 00002440 |
| 13 | 6 | 4 | | .250 | 16.13382 | | | | 00002450 |
| 13 | 6 | 7 | | .291 | 4.952746 | | | | 00002460 |
| 13 | 6 | 8 | | .439 | 8.074787 | | | | 00002470 |
| 13 | 6 | 9 | | .410 | 10.81887 | | | | 00002480 |
| 13 | 6 | 10 | 0.2075000 | 0.1224000 | 9.07808 | | | | 00002490 |
| 13 | 6 | 12 | 0.7238000 | 0.0308000 | 2.14232 | | | | 00002500 |
| 13 | 6 | 14 | 0.5110000 | 0.0345000 | 0.96138 | | | | 00002510 |
| 13 | 6 | 15 | 0.1050000 | 0.1479000 | 4.40562 | | | | 00002520 |
| 13 | 6 | 16 | | .119 | 3.759835 | | | | 00002530 |
| 13 | 6 | 17 | | .243 | 4.157416 | | | | 00002540 |
| 13 | 8 | | 0.44387 | 15.34930 | 0.89625 | 0.37738 | 6.59500 | 0.82641 | 00002550 |
| 13 | 8 | 1 | 20.2776 | 0.0 | -127.757 | | | | 00002560 |
| 13 | 8 | 2 | | .656 | 22.28342 | | | | 00002570 |
| 13 | 8 | 4 | | .510 | 12.83895 | | | | 00002580 |
| 13 | 8 | 7 | | .516 | 2.822829 | | | | 00002590 |
| 13 | 8 | 8 | 0.0 | 1.0 | 0.0 | | | | 00002600 |
| 13 | 8 | 9 | | .851 | 5.098415 | | | | 00002610 |
| 13 | 8 | 10 | 0.1694000 | 0.2281000 | 8.50694 | | | | 00002620 |
| 13 | 8 | 12 | 0.7157000 | 0.0540000 | 2.04980 | | | | 00002630 |
| 13 | 8 | 14 | 0.5175000 | 0.0253000 | 1.40055 | | | | 00002640 |
| 13 | 8 | 15 | 0.0417000 | 0.3146000 | 3.11505 | | | | 00002650 |
| 13 | 8 | 16 | | .215 | 2.803144 | | | | 00002660 |
| 13 | 8 | 17 | | .443 | 2.082673 | | | | 00002670 |
| 13 | 9 | | 0.64324 | 14.20918 | 0.89041 | 0.46605 | 3.79715 | 0.75792 | 00002680 |
| 13 | 9 | 1 | 20.2776 | 0.0 | -127.757 | | | | 00002690 |
| 13 | 9 | 2 | | .460 | 25.74404 | | | | 00002700 |
| 13 | 9 | 4 | | .358 | 15.52359 | | | | 00002710 |
| 13 | 9 | 7 | | .442 | 3.669475 | | | | 00002720 |
| 13 | 9 | 8 | | .725 | 4.712589 | | | | 00002730 |
| 13 | 9 | 9 | 0.0 | 1.0 | 0.0 | | | | 00002740 |
| 13 | 9 | 10 | 0.1909000 | 0.1234000 | 10.25960 | | | | 00002750 |
| 13 | 9 | 12 | 0.7041000 | 0.0552000 | 2.09503 | | | | 00002760 |
| 13 | 9 | 14 | 0.4824000 | 0.0720000 | 0.76467 | | | | 00002770 |
| 13 | 9 | 15 | 0.0173000 | 0.2545000 | 4.33329 | | | | 00002780 |
| 13 | 9 | 16 | | .165 | 3.598418 | | | | 00002790 |
| 13 | 9 | 17 | | .327 | 4.031488 | | | | 00002800 |
| 13 | 18 | | 1.08612 | 29.56165 | 1.66449 | 0.23848 | 3.97452 | 0.77995 | 00002810 |
| 13 | 18 | 1 | 20.2776 | 0.0 | -127.757 | | | | 00002820 |
| 13 | 18 | 2 | | .30976 | 22.51437 | | | | 00002830 |
| 13 | 18 | 4 | | .24063 | 13.03307 | | | | 00002840 |
| 13 | 18 | 7 | | .26725 | 1.93244 | | | | 00002850 |
| 13 | 18 | 8 | | .47770 | 0.11136 | | | | 00002860 |
| 13 | 18 | 9 | | .52243 | -0.10713 | | | | 00002870 |
| 13 | 18 | 10 | 0.16028 | 0.10150 | 9.00817 | | | | 00002880 |
| 13 | 18 | 12 | 0.70673 | 0.03051 | 1.97366 | | | | 00002890 |
| 13 | 18 | 14 | 0.49933 | 0.02766 | 0.95913 | | | | 00002900 |
| 13 | 18 | 15 | | 0.16506 | 3.09540 | | | | 00002910 |
| 13 | 18 | 16 | | .10537 | 2.70440 | | | | 00002920 |
| 13 | 18 | 17 | | .21390 | 2.027133 | | | | 00002930 |
| 14 | 2 | | 0.21453 | 34.61474 | 1.23950 | 0.07920 | 6.74895 | 0.75310 | 00002940 |
| 14 | 2 | 1 | 21.4816 | 0.0 | -33.422 | | | | 00002950 |
| 14 | 2 | 2 | 0.0 | 1.0000000 | 0.0 | | | | 00002960 |
| 14 | 2 | 4 | | .731 | -2.779322 | | | | 00002970 |
| 14 | 2 | 7 | | .247 | 5.090541 | | | | 00002980 |
| 14 | 2 | 8 | | .404 | 7.133844 | | | | 00002990 |
| 14 | 2 | 9 | | .333 | 11.566906 | | | | 00003000 |

Figure C-4. Distribution Tape File COMBIMAN.DBDATA (CBMAM): Sample Data to Create R67 USAF Regression Member and 67 USAF Survey Member of the COMBIMAN Anthropometric Data Base. (Continued)

```
14  2 10  0.2285000 0.1957000    6.64778
14  2 12  0.5291000 0.1814000    2.12145                                      00003010
14  2 14  1.0000000 0.0          0.0                                          00003020
14  2 15  0.1146000 0.1704000    3.28406                                      00003030
14  2 16             .117        3.232277                                     00003040
14  2 17             .193        4.728337                                     00003050
14  3        0.16752 30.25192    1.18027   0.06858   7.46870   0.75520        00003060
14  3  1 21.4816    0.0        -33.422                                        00003070
14  3  2            0.979        5.484241                                     00003080
14  3  4            0.737        0.55118                                      00003090
14  3  7             .260        5.86613                                      00003100
14  3  8             .403        9.114155                                     00003110
14  3  9             .349       12.661392                                     00003120
14  3 10  0.2413000 0.1746000    8.14076                                      00003130
14  3 12  0.5379000 0.1796000    2.96665                                      00003140
14  3 14  1.0000000 0.0          0.0                                          00003150
14  3 15  0.1229000 0.1691000    4.06737                                      00003160
14  3 16             .113        3.921252                                     00003170
14  3 17             .173        6.295263                                     00003180
14  5        0.42562 26.96411    1.30992   0.13572   5.43550   0.73744        00003190
14  5  1 21.4816    0.0        -33.422                                        00003200
14  5  2             .44707     22.78517                                      00003210
14  5  4             .35904     12.87857                                      00003220
14  5  7             .43726      0.56455                                      00003230
14  5  8            0.60737      3.07370                                      00003240
14  5  9            0.57349      5.95935                                      00003250
14  5 10  0.19936   0.16252      9.05942                                      00003260
14  5 12  0.51072   0.13482      4.76409                                      00003270
14  5 14  1.0000000 0.0          0.0                                          00003280
14  5 15            0.23926      3.20737                                      00003290
14  5 16             .18333      1.82567                                      00003300
14  5 17             .34779      1.00030                                      00003310
14  6        0.51986 26.59757    1.51637   0.12216   5.79212   0.73507        00003320
14  6  1 21.4816    0.0        -33.422                                        00003330
14  6  2             .330       26.25191                                      00003340
14  6  4             .250       16.13382                                      00003350
14  6  7             .291        4.952746                                     00003360
14  6  8             .439        8.074787                                     00003370
14  6  9             .410       10.81887                                      00003380
14  6 10  0.2008000 0.1334000    9.87646                                      00003390
14  6 12  0.5202000 0.0914000    5.97084                                      00003400
14  6 14  1.0000000 0.0          0.0                                          00003410
14  6 15  0.0690000 0.1574000    4.99869                                      00003420
14  6 16             .119        3.759835                                     00003430
14  6 17             .243        4.125976                                     00003440
14  8        0.36704 18.41054    0.94189   0.21947   4.83601   0.72834        00003450
14  8  1 21.4816    0.0        -33.422                                        00003460
14  8  2             .656       22.28342                                      00003470
14  8  4             .510       12.83855                                      00003480
14  8  7             .516        2.822829                                     00003490
14  8  8  0.0       1.0000000    0.0                                          00003500
14  8  9             .851        5.098415                                     00003510
14  8 10  0.1770000 0.2529000    8.77199                                      00003520
14  8 12  0.4880000 0.2164000    4.42040                                      00003530
14  8 14  1.0000000 0.0          0.0                                          00003540
14  8 15  0.0317000 0.3234000    3.23744                                      00003550
14  8 16             .215        2.803144                                     00003560
14  8 17             .443        2.082673                                     00003570
14  9        0.58391 18.14341    0.96724   0.29754   2.57875   0.69045        00003580
14  9  1 21.4816    0.0        -33.422                                        00003590
                                                                              00003600
```

Figure C-4. Distribution Tape File COMBIMAN.DBDATA (CBMAM): Sample Data to Create R67 USAF Regression Member and 67 USAF Survey Member of the COMBIMAN Anthropometric Data Base. (Continued)

```
 14   9   2                 .460        25.74404                                          00003610
 14   9   4                 .358        15.52359                                          00003620
 14   9   7                 .442        3.641725                                          00003630
 14   9   8                 .725        4.712589                                          00003640
 14   9   9  0.0           1.0000000     0.0                                              00003650
 14   9  10  0.1769000 0.1600000       10.52173                                           00003660
 14   9  12  0.4156000 0.2606000        3.67241                                           00003670
 14   9  14  1.0000000 0.0              0.0                                               00003680
 14   9  15 -0.0028000 0.2634000        4.40554                                           00003690
 14   9  16                 .165        3.598418                                          00003700
 14   9  17                 .327        4.031488                                          00003710
 14  18          0.95061  36.54801      1.79373    0.14674    2.94372   .70473            00003720
 14  18   1 21.4816      0.0          -33.422                                             00003730
 14  18   2                .30976      22.51437                                           00003740
 14  18   4                .24063      13.03307                                           00003750
 14  18   7                .26725       1.93244                                           00003760
 14  18   8                .47770       0.11136                                           00003770
 14  18   9                .52243      -0.10713                                           00003780
 14  18  10  0.15770     0.11659        9.18096                                           00003790
 14  18  12  0.44031     0.13444        3.48642                                           00003800
 14  18  14  1.0000000   0.0            0.0                                               00003810
 14  18  15              0.16506        3.09540                                           00003820
 14  18  16                .10537       2.70440                                           00003830
 14  18  17                .21390       2.027133                                          00003840
+ADD 67 USAF      1   18   28   12   25   R67 USAF                                        00003850
 1 2 3 5101520253035404550556065707580859095979899                                        00003860
 1 WEIGHT                  LB 173.60686 21.43470412758132631358214015146891515300003870
155271585616156164371670816974172421751317792180841839718741191321959l   00003880
20183210762166222094227773                                                                 00003890
 2 SITTING HEIGHT    IN 36.685932 1.2501624 3394 3424 3444 3470 3511 353900003900
 3562 3582 3600 3617 3633 3649 3665 3681 3698 3715 3733 3753 3775 3801  00003910
 3833 3880 3910 3931 3962                                                 00003920
 3 EYE HGT/SITTING   IN 31.869176 1.1871142 2917 2950 2971 2998 3038 306500003930
 3087 3106 3123 3138 3153 3168 3183 3198 3213 3229 3246 3265 3286 3311  00003940
 3343 3390 3421 3443 3478                                                 00003950
 4 ACROMION HGT/SIT IN 24.03821  1.123410  2142 2177 2197 2224 2263 228900003960
 2310 2327 2343 2358 2373 2387 2401 2415 2430 2445 2461 2479 2499 2522  00003970
 2551 2594 2620 2639 2666                                                 00003980
 5 ARM LENGTH         IN 31.07249 1.34508    2802 2837 2859 2890 2937 296900003990
 2995 3017 3037 3056 3073 3091 3108 3125 3142 3160 3179 3199 3223 3250  00004000
 3284 3335 3369 3394 3434                                                 00004010
 6 THUMB-TIP REACH  IN 31.62047  1.56498   2804 2846 2872 2908 2964 300100004020
 3030 3056 3079 3100 3120 3139 3158 3178 3198 3218 3240 3264 3291 3322  00004030
 3364 3427 3469 3502 3595                                                 00004040
 7 SHOULDR-ELB LGTH IN 14.15382   .674011  1265 1281 1291 1306 1329 134500004050
 1357 1368 1379 1388 1397 1406 1414 1423 1432 1441 1451 1461 1473 1486  00004060
 1503 1528 1544 1555 1573                                                 00004070
 8 KNEE HGT/SITTING IN 21.95673   .98041   1973 1998 2015 2037 2071 209500004080
 2113 2129 2143 2157 2169 2182 2194 2206 2219 2231 2245 2260 2277 2296  00004090
 2322 2360 2386 2405 2436                                                 00004100
 9 BUTTOCK-KNE LGTH IN 23.78431  1.06204   2138 2165 2183 2207 2244 226900004110
 2289 2306 2322 2336 2350 2363 2376 2389 2402 2416 2431 2447 2465 2486  00004120
 2514 2557 2587 2610 2648                                                 00004130
10 BIACROMIAL BRDTH IN 16.03454   .764311  1418 1441 1456 1475 1505 152500004140
 1541 1554 1566 1576 1586 1596 1605 1614 1624 1633 1643 1654 1666 1680  00004150
 1698 1726 1744 1758 1782                                                 00004160
11 BIDELTIOD BRDTH  IN 18.99046  1.00841   1667 1696 1714 1737 1772 179500004170
 1814 1830 1844 1858 1871 1884 1896 1909 1922 1936 1951 1967 1983 2005  00004180
 2032 2071 2097 2115 2142                                                 00004190
```

Figure C-4. Distribution Tape File COMBIMAN.DBDATA (CBMAM): Sample Data to Create R67 USAF Regression Member and 67 USAF Survey Member of the COMBIMAN Anthropometric Data Base. (Continued)

```
12 HIP BREADTH       IN 13.88310  .741637   1221 1241 1254 1271 1297 131400004200
 1328 1339 1350 1359 1368 1377 1386 1395 1404 1413 1423 1434 1447 1462  00004210
 1482 1515 1537 1555 1584
13 HIP BREADTH/SITT IN 14.87821   .90583    1286 1310 1325 1345 1375 139600004230
                                                                        00004220
 1412 1426 1439 1451 1462 1473 1484 1495 1506 1518 1531 1545 1561 1580  00004240
 1605 1644 1670 1690 1723
14 CHEST DEPTH       IN  9.65481   .75788    798  814  825  841  867  88500004260
                                                                        00004250
  900  913  925  936  946  956  965  975  985  994 1005 1016 1029 1043  00004270
 1062 1090 1110 1124 1149
15 FOOT LENGTH       IN 10.64335  .468125    957  970  979  989 1006 101700004290
                                                                        00004280
 1025 1033 1039 1046 1052 1057 1063 1069 1075 1081 1088 1095 1103 1113  00004300
 1125 1144 1156 1165 1180
16 HAND LENGTH       IN  7.52310  .322807    679  688  693  700  711  71900004320
                                                                        00004310
  725  730  735  739  743  747  751  755  760  764  769  774  779  786  00004330
  794  807  815  821  830
17 ELBOW-WRIST LGTH IN 11.81      .56       1052 1068 1077 1090 1110 112400004350
                                                                        00004340
 1134 1143 1151 1159 1166 1173 1180 1187 1194 1201 1209 1218 1227 1238  00004360
 1253 1274 1288 1299 1316
18 LEG LENGTH        IN 45.72089 1.93325    4135 4184 4216 4259 4327 437400004380
                                                                        00004370
 4410 4442 4471 4497 4522 4546 4570 4595 4619 4644 4671 4701 4734 4773  00004390
 4823 4899 4951 4991 5056
+END                                                                    00004400
                                                                        00004410
```

Figure C-4. Distribution Tape File COMBIMAN.DBDATA (CBMAM): Sample Data to Create R67 USAF Regression Member and 67 USAF Survey Member of the COMBIMAN Anthropometric Data Base. (Continued)

```
//COMBIMAN JOB CLASS=A,MSGCLASS=A,
//      TIME=(100,0),REGION=1024K
//*
//* ---------------------------------------------
//* -  COMBIMAN CREW STATION DATA BASE          -
//* -  MAINTENANCE PROGRAM JCL FILE.            -
//* ---------------------------------------------
//*
//CBMCM   EXEC PGM=CBMCM
//STEPLIB  DD DSN=COMBIMAN.LOADLIB,DISP=SHR
//*
//FT01F001 DD DSN=COMBIMAN.CRSTDATA,
//             UNIT=DISK,
//             DISP=(NEW,CATLG),
//             SPACE=(368,2000),
//             DCB=(RECFM=F,LRECL=368,BLKSIZE=368)
//*
//FT05F001 DD DSN=COMBIMAN.DBDATA(CBMCM),DISP=SHR,LABEL=(,,,IN)
//*
//FT06F001 DD SYSOUT=A
//FT07F001 DD DUMMY
//*
```

Figure C-5. Distribution Tape File COMBIMAN.PRODNJCL (CBMCM): Sample JCL to Run CBMCM.

```
$INT
$ADD A7E-01      46   46   0.0   0.0   0.0 F L U                                      00000010
 1LMIPAN          16  2975   000   594  2975  1475                                     00000020
 3259    957    1930  3320   450  2214  3320   000  2300                               00000020
```

```
$INT
$ADD A7E-01      46   46   0.0   0.0   0.0 F L U                                      00000010
 1LMIPAN          16  2975   000   594  2975  1475   594  3134  1475                   00000020
 3259    957    1930  3320   450  2214  3320   000  2300                          13390000000030
 2RMIPAN          16  2975   000   594  2975 -1475   594  3134 -1475                   00000040
 3259   -957    1930  3320  -450  2214  3320   000  2300                          13390000000050
 3FWDLHCON        15  2623   925   289  2623  1875   289  2831  1801                   00000060
 2979   1718     593  2979   928   593                                            46800000070
 4LHCON           14  2609   925   276  -840   925   276  -840  2301                   00000080
 2609   2000     275                                                              27600000090
 5AFTLHCON        14  -335   850   276  -853   850   276  -853  2352                   00000100
 -340   2300     275                                                              27600000110
 6FWDRHCON        15  2623  -925   289  2623 -1875   289  2831 -1801                   00000120
 2979  -1718     593  2979  -928   593                                            46800000130
 7RHCON           14  2609  -925   276  -840  -925   276  -840 -2353                   00000140
 2609  -2000     275                                                              27600000150
 8CNSWLFSD        14  2610   925   276  -336   925   276  -336   925                   00000160
 2610    925    -932                                                              -93200000170
 9CNSWLSRH        14  2610  -925   276  -336  -925   276  -336  -925                   00000180
 2610   -925    -932                                                              -93200000190
10UWPRLPAN        14  2974  -478   593  2947  -308   463  2947   308                   00000200
 2979    478     593                                                              46300000210
11LWPRLPAN        14  2947  -308   463  2904  -245   264  2904   245                   00000220
 2949    308     463                                                              26400000230
12THRTLLSD        16  1996  1393   790  1931  1393   765  1882  1393                   00000240
 1969   1388     513  2089  1388   693  2069  1388   763                          55900000250
13THRTLFWD        14  2092  1393   694  1973  1393   518  1973  1141                   00000260
 2089   1138     693                                                              51800000270
14THRTLRSD        16  1996  1141   790  1931  1141   765  1882  1141                   00000280
 1969   1138     513  2089  1138   693  2069  1138   763                          55900000290
15THRTLAFT        14  1931  1141   765  1882  1141   559  1882  1393                   00000300
 1929   1388     763                                                              55900000310
16THRTPAFT        14  1996  1141   790  1931  1141   765  1931  1393                   00000320
 1999   1388     793                                                              76500000330
17THRTLTPC        14  2066  1141   760  1996  1141   790  1996  1393                   00000340
 2069   1388     763                                                              79000000350
18THRTPFWD        14  2092  1141   694  2066  1141   760  2066  1393                   00000360
 2089   1388     693                                                              76000000370
19THRLOAFT        14  1905  1216   548  1783  1216   276  1783  1316                   00000380
 1909   1318     543                                                              27600000390
20THRLOFWD        14  1950  1216   527  1838  1216    27  1838   131                   00000400
 1949   1318     525                                                              27 00000410
21OLSHTP          14  2090    00  2602  5718    00  1776  5718    00                   00000420
 2090     00    2604                                                              17760000430
22HUDSCRN         14  2209   374  3226  2209  -374  3226  2901  -374                   00000440
 2901    374    2447                                                              24470000450
23CWFLLL          16  1730  1400  1494  1994  1389  2466  2208  1135                   00000460
 2208   1136    2995  1994  1390  2466  1730  1401  1494                          29950000470
24CWFMLL          16  2208  1135  2995  2261  1000  3128  2345   500                   00000480
 2365    501    3389  2261  1001  3128  2208  1136  2995                          33890000490
25CWFCL           16  2365   500  3389  2384   000  3433  2365  -500                   00000500
 2365   -500    3390  2384    00  3434  2365   500  3390                          33890000510
26CWFMRL          16  2365  -500  3389  2261 -1000  3128  2208 -1135                   00000520
 2208  -1136    2995  2261 -1001  3128  2365  -501  3389                          29950000530
27CWFLRL          16  2208 -1135  2995  1994 -1389  2466  1730 -1400                   00000540
 1730  -1401    1494  1994 -1390  2466  2208 -1136  2995                          14940000550
28CWRLLL          16 -1158  1782  1494 -1649  1500  2893 -1830  1200                   00000560
-1830   1201    3409 -1649  1501  2893 -1158  1783  1494                          34090000570
29CWRMLL          16 -1830  1200  3409 -1942   900  3730 -2014   600                   00000580
-2014    601    3934 -1942   901  3730 -1830  1201  3409                          39340000590
                                                                                   00000600
```

Figure C-6. Distribution Tape File COMBIMAN.DBDATA (CBMCM): Sample Data to Create COMBIMAN Crew Station Data Base Members A7E-01 and A7--SEAT, Using Program CBMCM.

```
30CWRULL        16 -2014   600  3934 -2054   300  4048 -2067   000  40850000610
-2067   000   4086 -2054   301  4048 -2014   601  3934                 00000620
31CWRURL        16 -2067   000  4085 -2054  -300  4048 -2014  -600  39340000630
-2014  -601   3934 -2054  -301  4048 -2067   000  4086                 00000640
32CWRMRL        16 -2014  -600  3934 -1942  -900  3730 -1830 -1200  34090000650
-1830 -1201   3409 -1942  -901  3730 -2014  -601  3934                 00000660
33CWRLRL        16 -1830 -1200  3409 -1650 -1500  2893 -1158 -1782  14940000670
-1158 -1783   1494 -1649 -1501  2893 -1830 -1201  3409                 00000680
34CWLBL         14  1730  1400  1494  1730  1405  1494 -1158  1787  14940000690
-1158  1782   1494                                                     00000700
35CWRBL         14  1730 -1400  1494  1730 -1405  1494 -1158 -1787  14940000710
-1158 -1782   1494                                                     00000720
36CFTRCL        14 -2067   001  4085   550   001  4072   550  -001  40720000730
-2067  -001   4085                                                     00000740
37CFTMCL        14   550   001  4072  1553   001  3884  1553  -001  38840000750
  550  -001   4072                                                     00000760
38CFTFCL        14  1553   001  3884  2665   001  3347  2665  -001  33470000770
 1553  -001   3884                                                     00000780
39WNDSCRN       14  2665   001  3347  5718   001  1776  5718  -001  17760000790
 2665  -001   3347                                                     00000800
40LRDRPDL       14  3748  1007    85  3748   463    85  3477   463  -6530000810
 3477  1007   -653                                                     00000820
41RRDRPDL       14  3748 -1007    85  3748  -463    85  3477  -463  -6530000830
 3477 -1007   -653                                                     00000840
42FLRLINE       14   391   925  -945  2131   925  -945  2131  -925  -9450000850
  391  -925   -945                                                     00000860
43LHLRSTLN      13  2131   925  -945  4208   925 -1161  4226   925  -9450000870
                                                                       00000880
44RHLRSTLN      13  2131  -925  -945  4208  -925 -1161  4226  -925  -9450000890
                                                                       00000900
45CHLRSTLN      14  4226   925  -945  4208   925 -1161  4208  -925 -11610000910
 4226  -925   -945                                                     00000920
46HUDFACE       14  2090    00  2602  2355    00  2139  3223    00  17410000930
 3320    00   2300                                                     00000940
AFTPTLT      0  00 -1108  2600  3125                                   00000950
AFTPTREA     0  00 -2958     0  2275                                   00000960
AFTPTRT      0  00 -1108 -2600 -9913                                   00000970
EMERPOWG     0  00  2589  1675   654                                   00000980
FCCATG       0  00  2059  1250   800                                   00000990
FCHKDOWN     0  00  2379 -1602   504                                   00001000
FCHKUP       0  00  2649 -1602   793                                   00001010
FCLDGGRU     0  00  2669  1043   800                                   00001020
FCRUDPDA     0  00  2784     0   114                                   00001030
FCSTKRPA     0  00  1647    34  1126                                   00001040
FCSTKRPM     0  00  2027    34  1151                                   00001050
FCTFADJ      0  00  1509   975   350                                   00001060
FCTHRTLA     0  00  1116  1266   704                                   00001070
FCTHRTLM     0  00  1593  1266   857                                   00001080
FIADAI       0  00  2449   543  2802                                   00001090
FIHUD        0  00  2799     0  2779                                   00001100
FISTBYCD     0  00  3183 -1575  1618                                   00001110
FWDPTLTD     0  00  4059  3500  2275                                   00001120
FWDPTRTU     0  00  4059 -3500  3475                                   00001130
IMPOSSRC     0  00  4869     0   -90                                   00001140
LONGLT       0  00   611  1542  1284                                   00001150
MAP CASE     0  00  -890 -1810   684                                   00001160
MSCANREL     0  00  1111 -1442   904                                   00001170
NUTRLSRP     0  00     1     0     0                                   00001180
RUDPDLAB     0  00  2869   725  -456                                   00001190
RUDPDLAN     0  00  3119   725  -506                                   00001200
```

Figure C-6. Distribution Tape File COMBIMAN.DBDATA (CBMCM): Sample Data to Create COMBIMAN Crew Station Data Base Members A7E-01 and A7--SEAT, Using Program CBMCM. (Continued)

```
RUDPDLAT       0  00  3369   725  -456
RUDPDLFB       0  00  3669   725  -506                                                  00001210
RUDPDLFN       0  00  3919   725  -556                                                  00001220
RUDPDLFT       0  00  4209   725  -506                                                  00001230
RUDPDRAB       0  00  2869  -725  -456                                                  00001240
RUDPDRAN       0  00  3119  -725  -506                                                  00001250
RUDPDRAT       0  00  3369  -725  -456                                                  00001260
RUDPDRFB       0  00  3669  -725  -506                                                  00001270
RUDPDRFN       0  00  3919  -725  -556                                                  00001280
RUDPDRFT       0  00  4169  -725  -506                                                  00001290
SNDSEATE       0  00    -6     0   -71                                                  00001300
SRP DOWN       0  00    59     0  -190                                                  00001310
SRP UP         0  00   -90     0   287                                                  00001320
STDPOSLH       0  00 27059     0 -9913                                                  00001330
STDPOSRH       0  00 27059     0 -9913                                                  00001340
STDPOSLF       0  00 27059     0 -9913                                                  00001350
STDPOSRF       0  00 27059     0 -9913                                                  00001360
STDPOSEY       0  00 27059     0 -9913                                                  00001370
WSARMREL       0  00  2908     0   389                                                  00001380
WSBPC          0  00  2259  1350   475                                                  00001390
$ADD A7--SEAT     5   1   0.0   0.0   0.0 F L U                                         00001400
001SBTP          14  -435  -750  2359     1  -750     0     1   750                     00001410
  -440   750   2363                                                                    000001420
002BKHDRST       14  -495  -350  3535  -350  -650  2655  -350   650                     00001430
  -495   350   3535                                                                 265500001440
003SPANMID       14    00  -750    00    00   750    00  1279   750                     00001450
  1279  -750   125                                                                  12500001460
004SPANFWDL      14  1277   225   131  1277   750   131  1720   750                     00001470
  1719   228   215                                                                  21200001480
005SPANFWDR      14  1277  -225   131  1277  -750   131  1720  -750                     00001490
  1719  -228   215                                                                  21200001500
DESEYE           00   0.0   0.0   0.0                                                   00001510
$END                                                                                    00001520
                                                                                        00001530
```

Figure C-6. Distribution Tape File COMBIMAN.DBDATA (CBMCM): Sample Data to Create COMBIMAN Crew Station Data Base Members A7E-01 and A7--SEAT, Using Program CBMCM. (Continued)

```
//COMBIMAN JOB   CLASS=A,MSGCLASS=A,
//       TIME=(100,0),REGION=1024K
//*
//* --------------------------------------------
//* -  COMBIMAN CREW STATION DATA BASE         -
//* -  MAINTENANCE PROGRAM JCL FILE.           -
//* --------------------------------------------
//*
//STEP1    EXEC PGM=CBMCM2
//*
//STEPLIB DD DSN=COMBIMAN.LOADLIB,DISP=SHR
//*
//FT05F001  DD  DSN=COMBIMAN.DBDATA(CBMCM2),DISP=SHR,LABEL=(,,,IN)
//*
//FT06F001  DD  SYSOUT=*
//FT07F001  DD  DUMMY
//*
//FT01F001  DD  DSN=COMBIMAN.CRSTDAT1,
//              UNIT=DISK,
//              DISP=(NEW,CATLG),
//              SPACE=(624,2000),
//              DCB=(RECFM=F,LRECL=624,BLKSIZE=624)
//*
```

Figure C-7.  Distribution Tape File COMBIMAN.PRODNJCL
(CBMCM2):  Sample JCL to Run CBMCM2.

```
$INT
$ADD A7E-01       46  46    0.0     0.0    0.0 F L U                                        00002100
  1LMIPAN      0    6                                                                        00002200
                       2975    000     594   2975   1475     594   3134   1475            00002300
                       3259    957    1930   3320    450    2214   3320    000      133900002400
  2RMIPAN      0    6                                                               230000002500
                       2975    000     594   2975  -1475     594   3134  -1475            00002600
                       3259   -957    1930   3320   -450    2214   3320    000      133900002700
  3FWDLHCON    0    5                                                               230000002800
                       2623    925     289   2623   1875     289   2831   1801            00002900
                       2979   1718     593   2979    928     593                    46800003000
  4LHCON       0    4                                                                   00003100
                       2609    925     276   -840    925     276   -840   2301            00003200
                       2609   2000     275                                          27600003300
  5AFTLHCON    0    4                                                                   00003400
                       -335    850     276   -853    850     274   -853   2352            00003500
                       -340   2300     275                                          27600003600
  6FWDRHCON    0    5                                                                   00003700
                       2623   -925     289   2623  -1875     289   2831  -1801            00003800
                       2979  -1718     593   2979   -928     593                    46800003900
  7RHCON       0    4                                                                   00004000
                       2609   -925     276   -840   -925     276   -840  -2353            00004100
                       2609  -2000     275                                          27600004200
  8CNSWLFSD    0    4                                                                   00004300
                       2610    925     276   -336    925     276   -336    925            00004400
                       2610    925    -932                                         -93200004500
  9CNSWLSRH    0    4                                                                   00004600
                       2610   -925     276   -336   -925     276   -336   -925            00004700
                       2610   -925    -932                                         -93200004800
 10UWPRLPAN    0    4                                                                   00004900
                       2974   -478     593   2947   -308     463   2947    308            00005000
                       2979    478     593                                          46300005100
 11LWPRLPAN    0    4                                                                   00005200
                       2947   -308     463   2904   -245     264   2904    245            00005300
                       2949    308     463                                          26400005400
 12THRTLLSD    0    6                                                                   00005500
                       1996   1393     790   1931   1393     765   1882   1393            00005600
                       1969   1388     513   2089   1388     693   2069   1388      55900005700
 13THRTLFWD    0    4                                                               76300005800
                       2092   1393     694   1973   1393     518   1973   1141            00005900
                       2089   1138     693                                          51800006000
 14THRTLRSD    0    6                                                                   00006100
                       1996   1141     790   1931   1141     765   1882   1141            00006200
                       1969   1138     513   2089   1138     693   2069   1138      55900006300
 15THRTLAFT    0    4                                                               76300006400
                       1931   1141     765   1882   1141     559   1882   1393            00006500
                       1929   1388     763                                          55900006600
 16THRTPAFT    0    4                                                                   00006700
                       1996   1141     790   1931   1141     765   1931   1393            00006800
                       1999   1388     793                                          76500006900
 17THRTLTPC    0    4                                                                   00007000
                       2066   1141     760   1996   1141     790   1996   1393            00007100
                       2069   1388     763                                          79000007200
 18THRTPFWD    0    4                                                                   00007300
                       2092   1141     694   2066   1141     760   2066   1393            00007400
                       2089   1388     693                                          76000007500
 19THRLGAFT    0    4                                                                   00007600
                       1909   1216     548   1783   1216     276   1783   1316            00007700
                       1909   1318     543                                          27600007800
                                                                                        00007900
```

Figure C-8. Distribution Tape File COMBIMAN.DBDATA (CBMCM2): Sample Data to Create COMBIMAN Crew Station Data Base Members A7E-01 and A7--SEAT, Using Program CBMCM2.

```
20THRLGFWD   0   4                                                00008000
      1950  1216   527  1838  1216    27  1838   131    27 00008100
      1949  1318   525                                        00008200
21GLSHTP     0   4                                                00008300
      2090    00  2602  5718    00  1776  5718    00  177600008400
      2090    00  2604                                        00008500
22HUDSCRN    0   4                                                00008600
      2209   374  3226  2209  -374  3226  2901  -374  244700008700
      2901   374  2447                                        00008800
23CWFLLL     0   6                                                00008900
      1730  1400  1494  1994  1389  2466  2208  1135  299500009000
      2208  1136  2995  1994  1390  2466  1730  1401  149400009100
24CWFMLL     0   6                                                00009200
      2208  1135  2995  2261  1000  3128  2365   500  338900009300
      2365   501  3389  2261  1001  3128  2208  1136  299500009400
25CWFCL      0   6                                                00009500
      2365   500  3389  2384   000  3433  2365  -500  338900009600
      2365  -500  3390  2384    00  3434  2365   500  339000009700
26CWFMRL     0   6                                                00009800
      2365  -500  3389  2261 -1000  3128  2208 -1135  299500009900
      2208 -1136  2995  2261 -1001  3128  2365  -501  338900010000
27CWFLRL     0   6                                                00010100
      2208 -1135  2995  1994 -1389  2466  1730 -1400  149400010200
      1730 -1401  1494  1994 -1390  2466  2208 -1136  299500010300
28CWRLLL     0   6                                                00010400
     -1158  1782  1494 -1649  1500  2893 -1830  1200  340900010500
     -1830  1201  3409 -1649  1501  2893 -1158  1783  149400010600
29CWRMLL     0   6                                                00010700
     -1830  1200  3409 -1942   900  3730 -2014   600  393400010800
     -2014   601  3934 -1942   901  3730 -1830  1201  340900010900
30CWRULL     0   6                                                00011000
     -2014   600  3934 -2054   300  4048 -2067   000  408900011100
     -2067   000  4086 -2094   301  4048 -2014   601  393400011200
31CWRURL     0   6                                                00011300
     -2067   000  4089 -2054  -300  4048 -2014  -600  393400011400
     -2014  -601  3934 -2054  -301  4048 -2067   000  408600011500
32CWRMRL     0   6                                                00011600
     -2014  -600  3934 -1942  -900  3730 -1830 -1200  340900011700
     -1830 -1201  3409 -1942  -901  3730 -2014  -601  393400011800
33CWRLRL     0   6                                                00011900
     -1830 -1200  3409 -1650 -1500  2893 -1158 -1782  149400012000
     -1158 -1783  1494 -1649 -1501  2893 -1830 -1201  340900012100
34CWLBL      0   4                                                00012200
      1730  1400  1494  1730  1405  1494 -1158  1787  149400012300
     -1158  1782  1494                                        00012400
35CWRBL      0   4                                                00012500
      1730 -1400  1494  1730 -1405  1494 -1158 -1787  149400012600
     -1158 -1782  1494                                        00012700
36CFTRCL     0   4                                                00012800
     -2067   001  4085   550   001  4072   550  -001  407200012900
     -2067  -001  4085                                        00013000
37CFTMCL     0   4                                                00013100
       550   001  4072  1553   001  3884  1553  -001  388400013200
       550  -001  4072                                        00013300
38CFTFCL     0   4                                                00013400
      1553   001  3884  2665   001  3347  2665  -001  334700013500
      1553  -001  3884                                        00013600
39WNDSCRN    0   4                                                00013700
      2665   001  3347  5718   001  1776  5718  -001  177600013800
      2665  -001  3347                                        00013900
```

Figure C-8. Distribution Tape File COMBIMAN.DBDATA (CBMCM2): Sample Data to Create COMBIMAN Crew Station Data Base Members A7E-01 and A7--SEAT, Using Program CBMCM2. (Continued)

```
     40OLRDRPDL    0    4
                            3748  1007    85  3748   463    85  3477   463      00014000
                            3477  1007  -653                                  -65300014100
     41RRDRPDL     0    4                                                       00014200
                            3748 -1007    85  3748  -463    85  3477  -463      00014300
                            3477 -1007  -653                                  -65300014400
     42FLRLINE     0    4                                                       00014500
                             391   925  -945  2131   925  -945  2131  -925      00014600
                             391  -925  -945                                  -94500014700
     43LHLRSTLN    0    3                                                       00014800
                            2131   925  -945  4208   925 -1161  4226   925      00014900
     44RHLRSTLN    0    3                                                     -94500015000
                            2131  -925  -945  4208  -925 -1161  4226  -925      00015100
     45CHLRSTLN    0    4                                                     -94500015200
                            4226   925  -945  4208   925 -1161  4208  -925      00015300
                            4226  -925  -945                                 -116100015400
     46HUDFACE     0    4                                                       00015500
                            2090    00  2602  2355    00  2139  3223    00      00015600
                            3320    00  2300                                   174100015700
   AFTPTLT         0   00  -1108  2600  3125                                    00015800
   AFTPTREA        0   00  -2958     0  2275                                    00015900
   AFTPTRT         0   00  -1108 -2600 -9913                                    00016000
   EMERPOWO        0   00   2589  1675   654                                    00016100
   FCCATG          0   00   2059  1250   800                                    00016200
   FCHKDOWN        0   00   2379 -1602   504                                    00016300
   FCHKUP          0   00   2649 -1602   793                                    00016400
   FCLDOORU        0   00   2669  1043   800                                    00016500
   FCRUDPDA        0   00   2784     0   114                                    00016600
   FCSTKRPA        0   00   1647    34  1126                                    00016700
   FCSTKRPM        0   00   2027    34  1151                                    00016800
   FCTFADJ         0   00   1509   975   350                                    00016900
   FCTHRTLA        0   00   1116  1266   704                                    00017000
   FCTHRTLM        0   00   1593  1266   857                                    00017100
   FIADAI          0   00   2449   543  2802                                    00017200
   FIHUD           0   00   2799     0  2779                                    00017300
   FISTBYCO        0   00   3183 -1575  1618                                    00017400
   FWDPTLTD        0   00   4059  3500  2275                                    00017500
   FWDPTRTU        0   00   4059 -3500  3475                                    00017600
   IMPOSSRC        0   00   4869     0   -90                                    00017700
   LONGLT          0   00    611  1542  1284                                    00017800
   MAP CASE        0   00   -890 -1810   684                                    00017900
   MSCANREL        0   00   1111 -1442   904                                    00018000
   NUTRLSRP        0   00      1     0     0                                    00018100
   RUDPDLAB        0   00   2869   725  -456                                    00018200
   RUDPDLAN        0   00   3119   725  -506                                    00018300
   RUDPDLAT        0   00   3369   725  -456                                    00018400
   RUDPDLFB        0   00   3669   725  -506                                    00018500
   RUDPDLFN        0   00   3919   725  -556                                    00018600
   RUDPDLFT        0   00   4209   725  -506                                    00018700
   RUDPDRAB        0   00   2869  -725  -456                                    00018800
   RUDPDRAN        0   00   3119  -725  -506                                    00018900
   RUDPDRAT        0   00   3369  -725  -456                                    00019000
   RUDPDRFB        0   00   3669  -725  -506                                    00019100
   RUDPDRFN        0   00   3919  -725  -556                                    00019200
   RUDPDRFT        0   00   4169  -725  -506                                    00019300
   SNDSEATE        0   00     -6     0   -71                                    00019400
   SRP DOWN        0   00     59     0  -190                                    00019500
   SRP UP          0   00    -90     0   287                                    00019600
   STDPOSLH        0   00  27059     0 -9913                                    00019700
   STDPOSRH        0   00  27059     0 -9913                                    00019800
                                                                                00019900
```

Figure C-8. Distribution Tape File COMBIMAN.DBDATA (CBMCM2): Sample Data to Create COMBIMAN Crew Station Data Base Members A7E-01 and A7--SEAT, Using Program CBMCM2. (Continued)

```
STDPOSLF       0   00 27059       0 -9913                                                  00020000
STDPOSRF       0   00 27059       0 -9913                                                  00020100
STDPOSEY       0   00 27059       0 -9913                                                  00020200
WSARMREL       0   00  2908       0   389                                                  00020300
WSBPC          0   00  2259    1350   475                                                  00020400
$ADD A7--SEAT      5    1    0.0    0.0    0.0 F L U                                       00020500
  1SBTP        0    4                                                                      00020600
                      -435   -750   2359      1   -750      0      1    750               000020700
                      -440    750   2363                                                   00020800
  2BKHDRST     0    4                                                                      00020900
                      -495   -350   3535   -350   -650   2655   -350    650            265500021000
                      -495    350   3535                                                   00021100
  3SPANMID     0    4                                                                      00021200
                        00   -750     00     00    750     00   1279    750             12500021300
                      1279   -750    125                                                   00021400
  4SPANFWDL    0    4                                                                      00021500
                      1277    225    131   1277    750    131   1720    750             21200021600
                      1719    228    215                                                   00021700
  5SPANFWDR    0    4                                                                      00021800
                      1277   -225    131   1277   -750    131   1720   -750             21200021900
                      1719   -228    215                                                   00022000
DESEYE                00   0.0    0.0    0.0                                               00022100
$END                                                                                       00022200
```

Figure C-8. Distribution Tape File COMBIMAN.DBDATA (CBMCM2): Sample Data to Create COMBIMAN Crew Station Data Base Members A7E-01 and A7--SEAT, Using Program CBMCM2. (Continued)

```
//COMBIMAN JOB UDRI,OVERLAY,CLASS=A,MSGCLASS=A,
//             REGION=1024K
//*
//* ----------------------------------------
//* -  COMBIMAN VISION LIMIT OVERLAY DATA  -
//* -  BASE MAINTENANCE PROGRAM JCL FILE.  -
//* ----------------------------------------
//*
//CBMODM   EXEC PGM=CBMODM
//STEPLIB   DD  DSN=COMBIMAN.LOADLIB,DISP=SHR
//*
//FT01F001 DD   DSN=COMBIMAN.OVERLAY.BASE,
//              UNIT=SYSDA,
//              DISP=(NEW,CATLG,DELETE),
//              SPACE=(800,16)
//*
//FT05F001 DD   DSN=COMBIMAN.DBDATA(CBMODM),
//              DISP=SHR,LABEL=(,,,IN)
//*
//FT06F001 DD   SYSOUT=A
//*
```

Figure C-9. Distribution Tape File COMBIMAN.PRODNJCL (CBMODM): Sample JCL to Run CBMODM.

```
$INT                                                    00000100
$ADD BASE LINE                 023                      00000200
  -57.0      -67.0                                      00000300
  -92.0      -50.0                                      00000400
 -102.0      -29.0                                      00000500
 -103.0      -10.0                                      00000600
  -99.0       10.0                                      00000700
  -84.0       30.0                                      00000800
  -59.0       46.0                                      00000900
  -29.0       53.0                                      00001000
    0.0       53.0                                      00001100
   29.0       53.0                                      00001200
   59.0       46.0                                      00001300
   84.0       30.0                                      00001400
   99.0       10.0                                      00001500
  103.0      -10.0                                      00001600
  102.0      -29.0                                      00001700
   92.0      -50.0                                      00001800
   57.0      -67.0                                      00001900
   30.0      -66.0                                      00002000
    [illegible].0      -63.0                            00002100
    [illegible].0      -56.0                            00002200
  -15.0      -63.0                                      00002300
  -30.0      -66.0                                      00002400
  -57.0      -67.0                                      00002500
$ADD HGU-22P & MBU-59          021                      00002600
  -34.0      -57.0                                      00002700
  -66.0      -48.0                                      00002800
  -84.0      -30.0                                      00002900
  -91.0      -10.0                                      00003000
  -93.0       10.0                                      00003100
  -81.0       30.0                                      00003200
  -50.0       42.0                                      00003300
  -22.0       46.0                                      00003400
    0.0       45.0                                      00003500
   22.0       46.0                                      00003600
   50.0       42.0                                      00003700
   81.0       30.0                                      00003800
   93.0       10.0                                      00003900
   91.0      -10.0                                      00004000
   84.0      -30.0                                      00004100
   66.0      -48.0                                      00004200
   34.0      -57.0                                      00004300
   15.0      -45.0                                      00004400
    0.0      -40.0                                      00004500
  -15.0      -45.0                                      00004600
  -34.0      -57.0                                      00004700
$END                                                    00004800
/*                                                      00004900
//                                                      00005000
```

Figure C-10. Distribution Tape File COMBIMAN.DBDATA(CBMODM): Sample Data to Create COMBIMAN Vision Limit Overlay Data Base with Overlays BASE LINE and HGU-22P and MBU-59.

APPENDIX D

FLOW DIAGRAM FOR THE
STRENGTH ANALYSIS FUNCTION (PFK19)

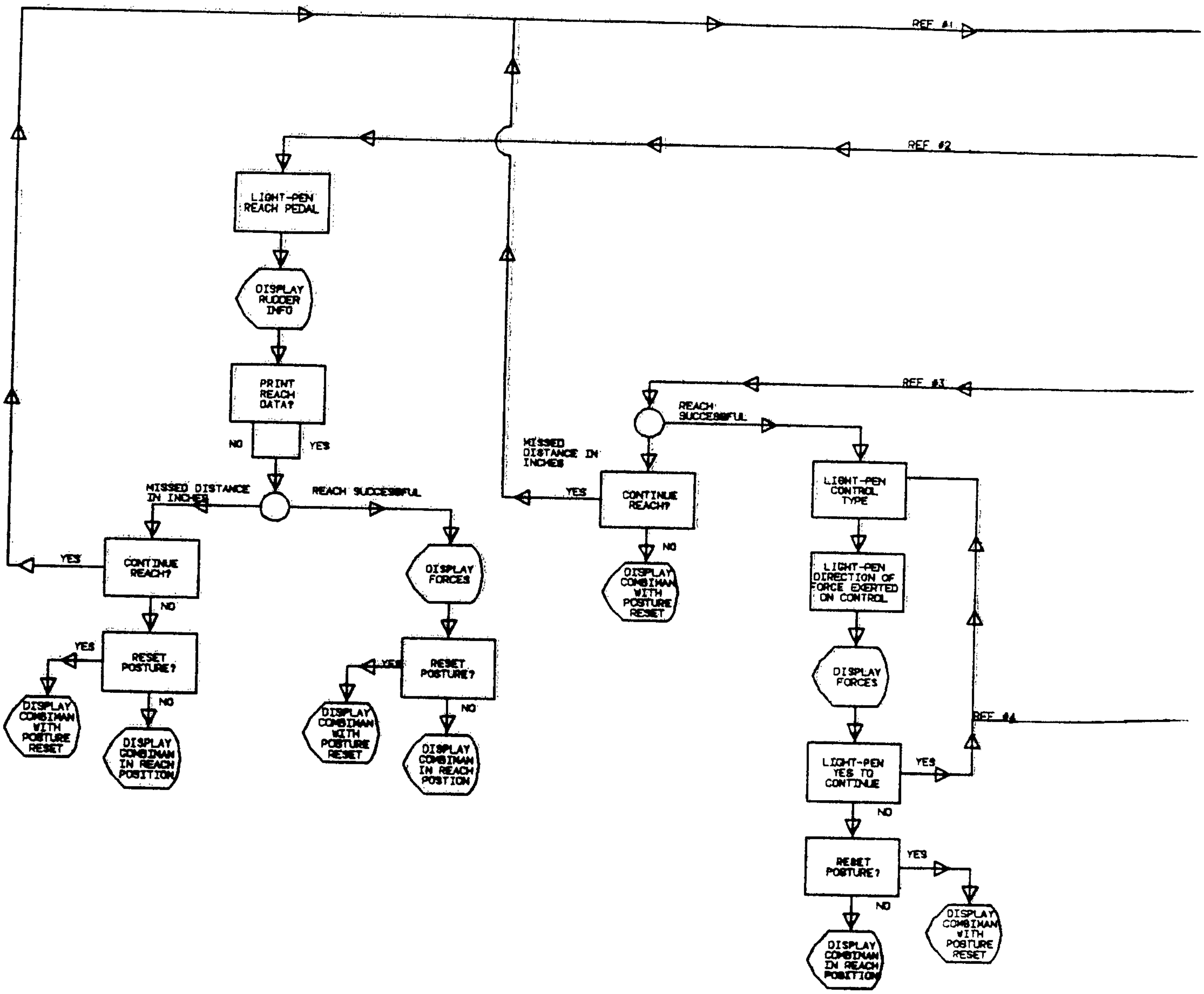



Figure D-1. Flow Diagram for the Strength Analysis Function (PFK19).

START

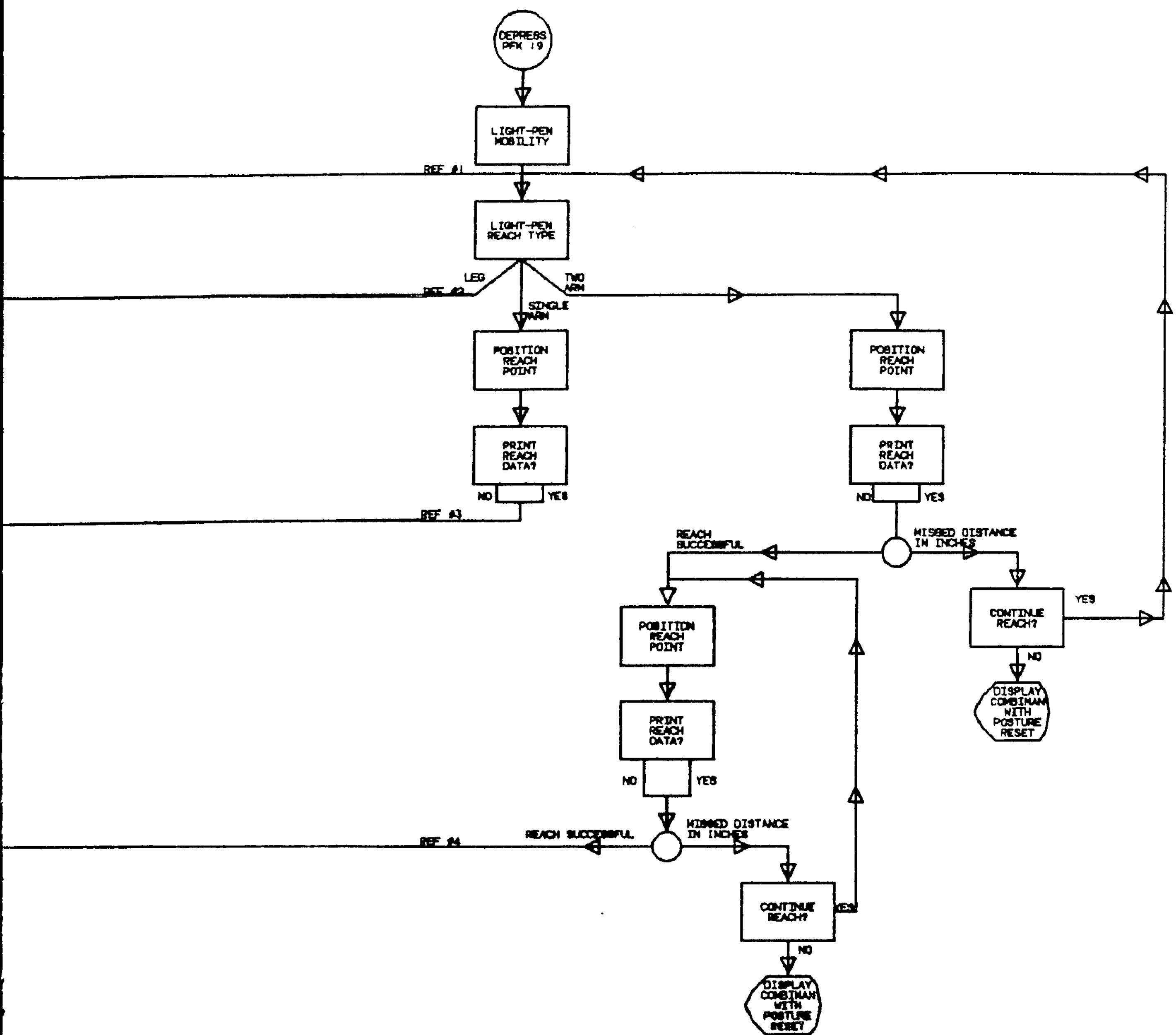



Figure D-1. Flow Diagram for the Strength Analysis Function (PFK19). (Continued)

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